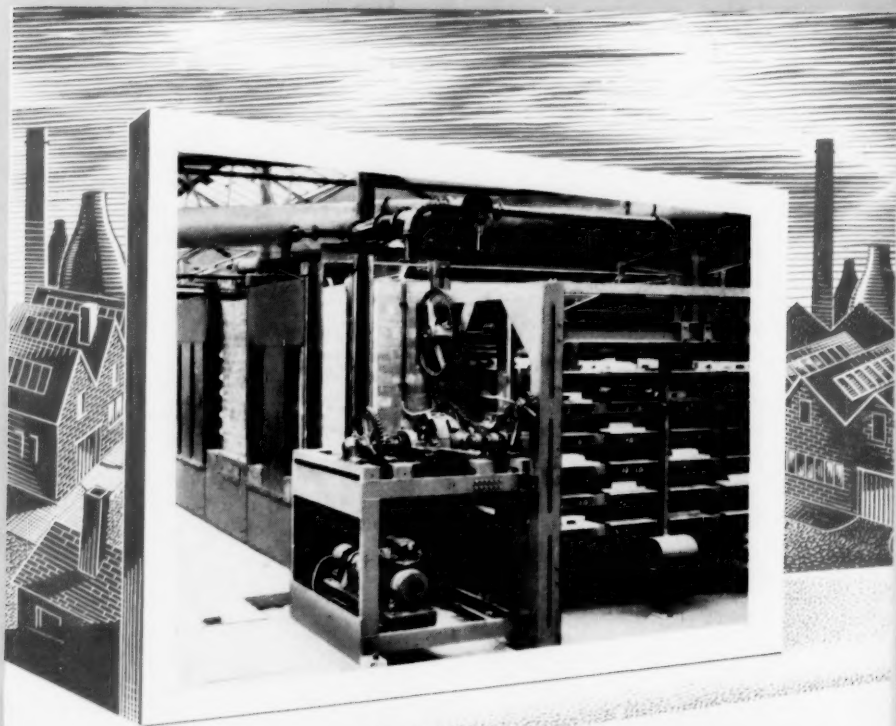


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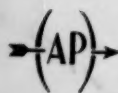
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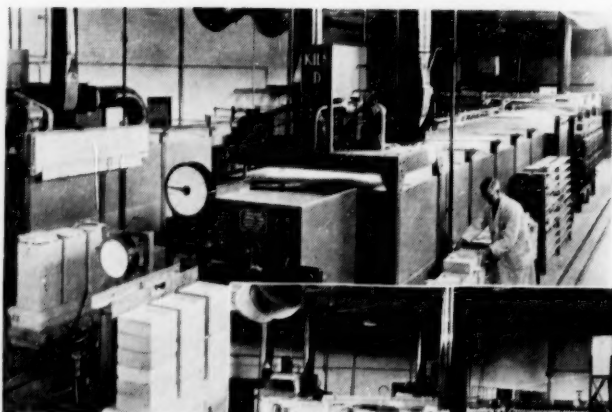


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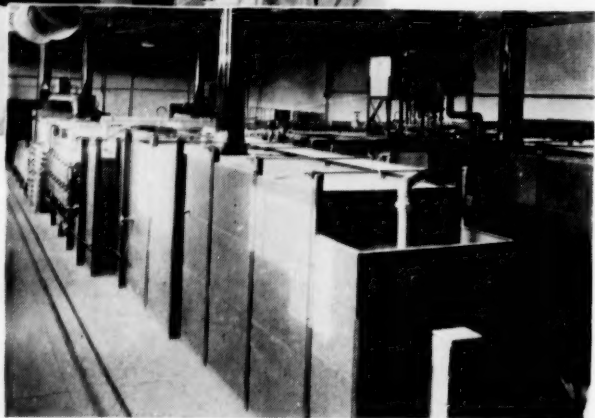
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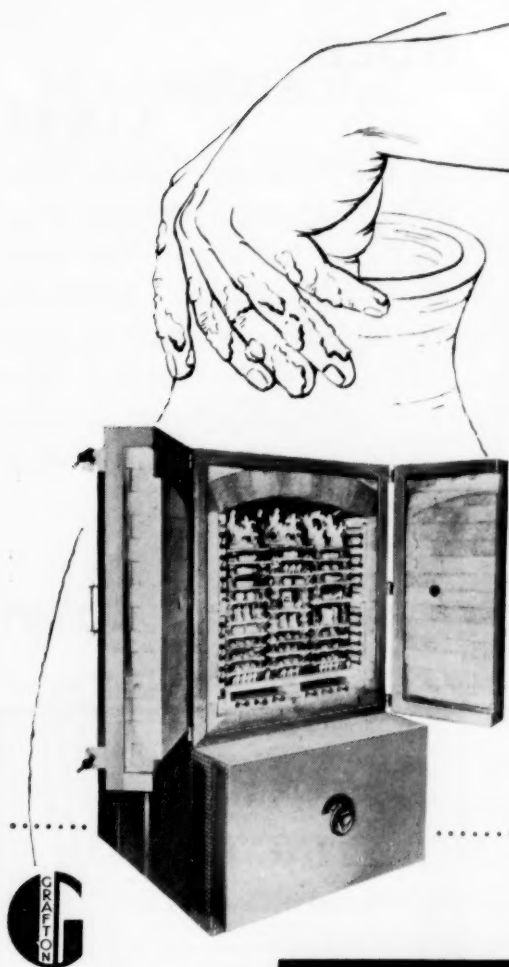
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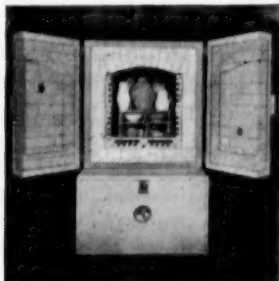
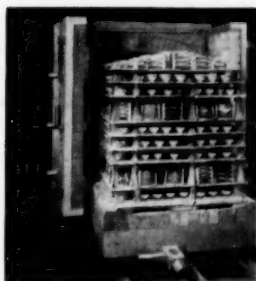
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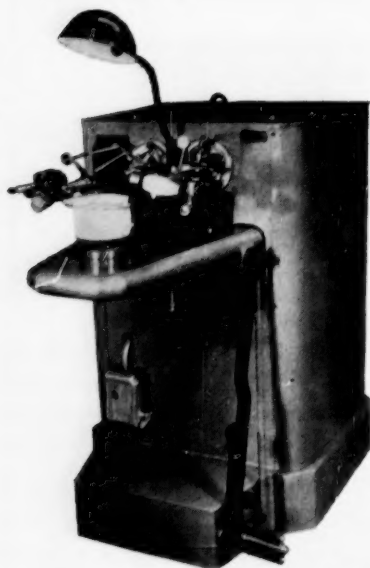


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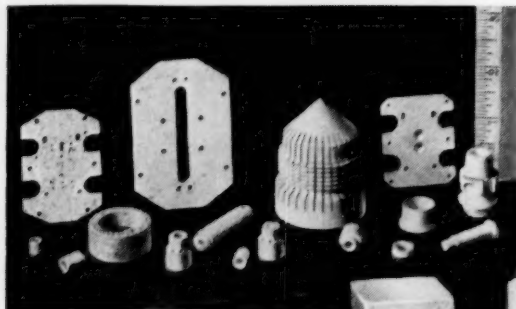
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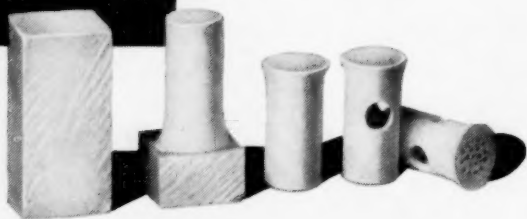


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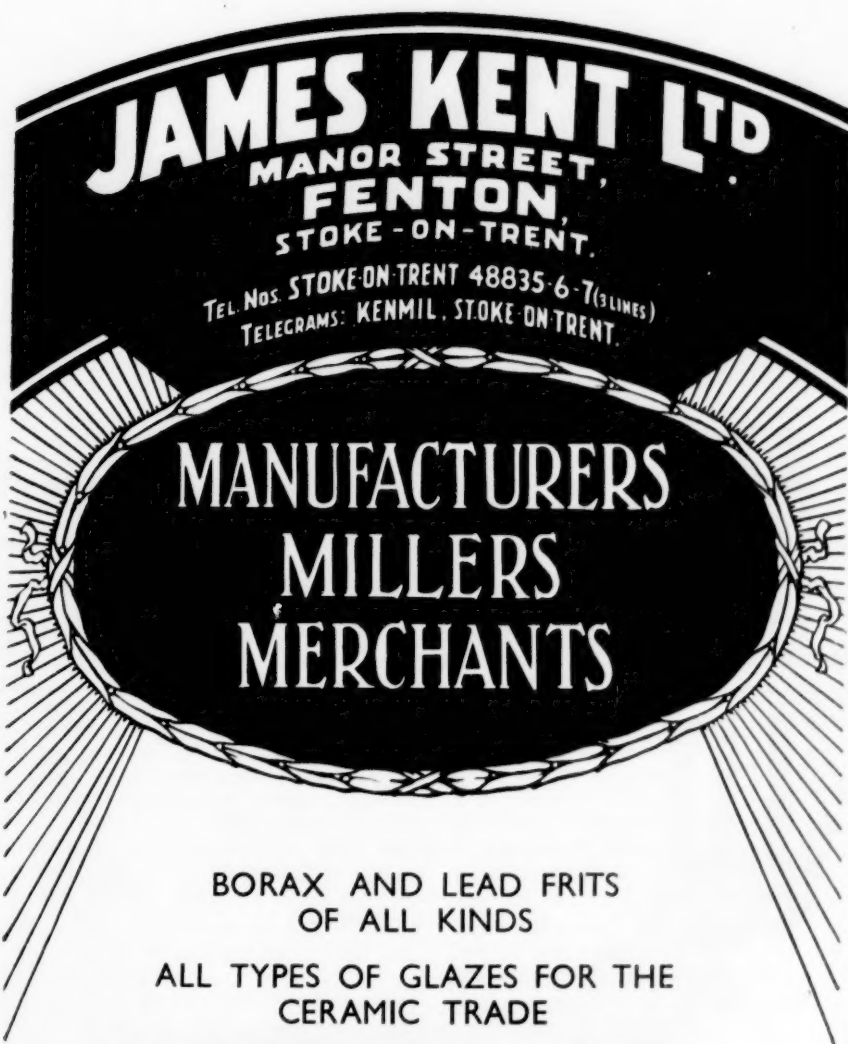


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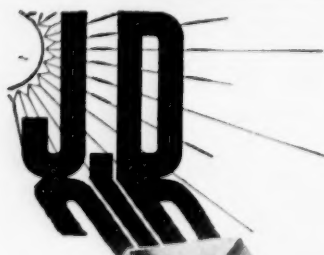
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ARROW PRESS LTD.,

157 Hagden Lane,

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DIRECTORS:

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CERAMICS

A monthly journal covering the pottery, glass,
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DECEMBER 1954

FEATURE ARTICLES

	Page
EDITORIAL	443
REFRATORIES FOR THE STEEL INDUSTRY	444
ULTRASONIC MACHINING OF CERAMICS	450
AUTOMATIC CONTROL OF MOLTEN LIQUID LEVEL	454
A VISIT TO DELFT. By Gillian Craig	457
MORGANS—A PERSONAL IMPRESSION. By W. F. Coxon	463
POUNTNEY'S OF BRISTOL	464

MISCELLANEOUS

COLOUR IN CERAMICS	456
NEW MORGAN RESEARCH DEPARTMENT	460
SOUTH AFRICAN NEWS	467
NEW CHEMICAL PRODUCT DISPLAY	469
GLASS TO GLASS CEMENT	470
NEWS IN BRIEF	471
CLASSIFIED ADVERTISEMENTS	475
ADVERTISERS' INDEX	475

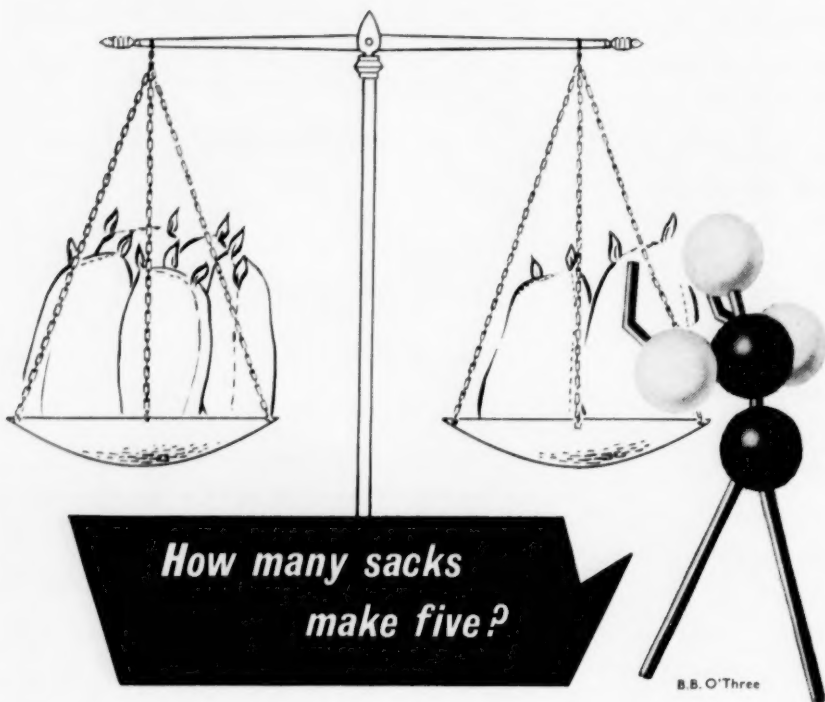
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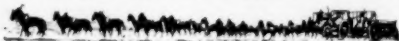
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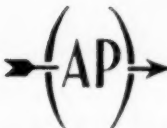
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Ceramics



VOL. VI

DECEMBER, 1954

NO. 70

Bricks from Fly Ash

IT would look as though the British Electricity Authority is about to invade the ceramic field, particularly in so far as concrete and brick-making are concerned.

As a result of burning pulverised coal the output of fuel ash from the power stations is now some two million tons a year and expected to rise to some four million tons by 1960. It is estimated by the British Electricity Authority that it costs them some £½ million a year merely to dispose of this material. In effect it is similar to the volcanic ashes which were used by the Romans in combination with limestone and a cementing material to build monuments like the Coliseum and the Pantheon.

The British Electricity Authority has been working for some time in close collaboration with the Building Research Station which is, of course, part of the Department of Scientific and Industrial Research. Between them they have established the fact that bricks to the normal British Standard Specifications can be made by this material, using up to 80 or 90 per cent. of the fuel ash. Bricks have already been made from ashes from different power stations. Apparently the position is that the British Electricity Authority could build brickworks and use the bricks to supply their own demands. They would wish, however, to work as closely as possible with the traditional brick-makers. However, since the transport of fly ash is relatively expensive, fullest advantages are only achieved where a brickworks is built near to the power station. When the clay pit of a brickworks is running out this might well be worth serious thought. The Authority is out to consider any offers by brickmakers to use their sites in their development plans.

Already in the United States, Canada and in Europe the use of fly ash has been extended to include concrete, building bricks and sintered lightweight aggregates.

Many of these applications, however, have as yet not gone beyond the stage of pilot experiments and developments.

As far as the ceramic industry is concerned there is no doubt that this new material is here to stay, and one feels sure that progressive manufacturers will be the first to get together with the British Electricity Authority to see how this fly ash can be considered as a raw material in their trade.

Refractories for the Steel Industry

(SPECIALLY CONTRIBUTED)

IN the last issue some consideration was given to refractories for the blast furnace. In this article the process of steel making will be considered with particular reference to the demands it makes on refractory materials.

Steel making irons contain 3-4 per cent. of carbon, typical analyses being:

	Basic (per cent.)	Haematite (per cent.)
Carbon ...	3.5	3.75
Silicon ...	0.85	2.0
Sulphur ...	0.08	0.04
Phosphorous ...	1.6	0.045
Manganese ...	1.0	0.5

(A Simple Guide to the Basic Processes in the Iron and Steel Industry—British Iron and Steel Federation Handbook.)

To convert these irons to steel involves removing most of the carbon together with other elements like silicon, sulphur and phosphorus. A typical mild steel according to the same authority quoted above may contain:

	per cent.
Carbon ...	0.15
Silicon ...	0.03
Sulphur ...	0.05
Phosphorus ...	0.05
Manganese ...	0.5

The type of steel is classified on its carbon content as follows:

1. Low carbon steels: (a) less than 0.07 per cent. carbon; (b) 0.07-0.15 per cent. carbon.
2. Mild steels: 0.15-0.25 per cent.
3. Medium carbon steels: 0.2-0.5 per cent.
4. High carbon steels: 0.5-1.4 per cent.

Increasing carbon content makes the steel hard and vice versa. The steel-maker's job is to regulate the carbon

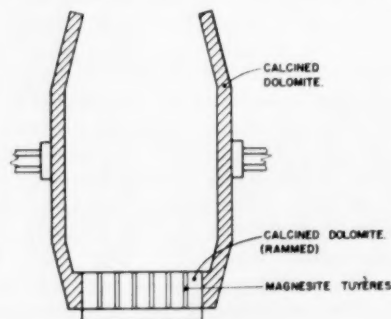
content, and to remove unwanted impurities, especially phosphorus and silicon. Removal of the carbon is done essentially by oxidation, whereby it is converted to carbon monoxide and finally to the dioxide.

In the Bessemer process the oxidation is done by a blast of hot air, in the open hearth process the oxidation is brought about by hot air and by additions of ferric oxide—



The Bessemer Process

This process dates from 1856. The molten iron is poured into a converter, which consists of a pear-shaped steel vessel lined with refractory bricks. The bottom carries holes through which hot air can be blown and the vessel is mounted so that it can readily be tipped for fillings or pouring (Fig. 1). Its capacity varies from about 10-60 tons of metal. The original converter had a lining of silica bricks which would not remove phosphorus oxide. It could thus only be used for irons low in phosphorus, since the silica



BASIC BESSEMER CONVERTER
(DIAGRAMMATIC)

Fig. 1

lining gave an acid slag (acid process). Gilchrist and Thomas introduced the basic lining of calcined dolomite about twenty years later, and thus enabled large deposits of ores containing phosphorus to be utilised. In this process the phosphorus is oxidised to the pentoxide, which then combines with the lime and magnesia in the calcined dolomite to form a basic slag. The latter is sold as a phosphatic fertiliser. In 1946 it was estimated that about $7\frac{1}{2}$ per cent. of the steel used in this country was made by the Bessemer method and of this 1.75 per cent. was done with the acid process and the rest by the basic.

Metal is not usually charged directly into the Bessemer converters from the blast furnace, but is taken from a mixer. This consists of a cylindrical vessel of from 250-1,400 tons capacity. For the acid process the lining is made of silica brick. According to Dr. J. H. Chesters (*Steel Plant Refractories*, Sheffield, 1944) soft-fired bricks are often preferred as there is less risk of spalling, and after expansion probably tightens up the joints. Magnesite or sea-water magnesia is used for the linings in the basic process. This must be properly fired to reduce shrinkage, which would allow metal to penetrate the lining. The magnesite is usually backed with insulating bricks.

The converter itself is lined with silica brick for the acid process. The thickness of the linings depends on the size of the converter. For a 25-ton model about 10 ft. 6 in. inside dia. at the widest point, the wall might have a thickness of 15 in. while the bottom is thicker. Rammed monolithic linings made from quartzite with and without a clay bond have also been used.

Basic Bessemer Process

For this process the tarred basic (calcined dolomite) is used either as blocks formed under high pressure or as monolithic rammed linings. The tar used in the latter case varies from 5-7 per cent. The converter is broken in by charging with hot coke, and later iron and lime, and blowing till a slag of a certain composition is formed. At the end of this fire the lining is coated with a layer of slag and is ready for use. For further details J. H. Chesters (*op. cit.*) should be consulted. The life

of the lining is of the order of 160-200 blows. The bottom will probably need renewing after about only one quarter of this number of blows. In the acid process the life is longer.

Tuyeres

The tuyeres for the acid process are made of an approximately 38 per cent. alumina fireclay (Seger cone 31), with a porosity of approximately 20 per cent. Their thermal shock resistance is good. The spaces between are filled with spacers made of much the same material, and a rammed mixture of fireclay grog and aluminous fireclay.

In the basic process the tuyeres can be made of magnesite, and the spaces between them filled with rammed, tarred basic, or the bottom may be made as a monolithic structure, either rammed with a low tar content, or poured with a higher tar content. The bottom is then slowly heated to 500-750° C. in a tunnel kiln, about a week being needed to pass through—the aim being to turn the tar to coke without burning or draining off the tar. Properly made bottoms can be stored in their metal cases for months without deterioration (J. H. Chesters, *op. cit.*).

Operation of Converter

To make steel the pig iron is poured into the converter, burnt lime having been previously added at the rate of about 8-10 per cent. of the weight of iron. The air blast is turned on as the converter is slowly turned into the upright position, a pressure sufficient to blow air through the molten metal being used. Oxidation of carbon, manganese and silicon causes flames to spurt out of the converter, and the liquid boils violently. When all the carbon has been burnt out the flame suddenly drops (about 20 min.). After this, oxidation of phosphorus gives brown fumes lasting 2-3 min. At this stage the operator can tell by the appearance of the flame when to take a sample. This is tested by hammering. A sample which breaks up easily, or has a crystalline appearance when broken, indicates that the oxidation of phosphorus is not completed, and the blow is continued till the sample is satisfactory. Since this process oxidises all the carbon it is necessary to add an alloy of iron, manganese and carbon (ferro manganese).

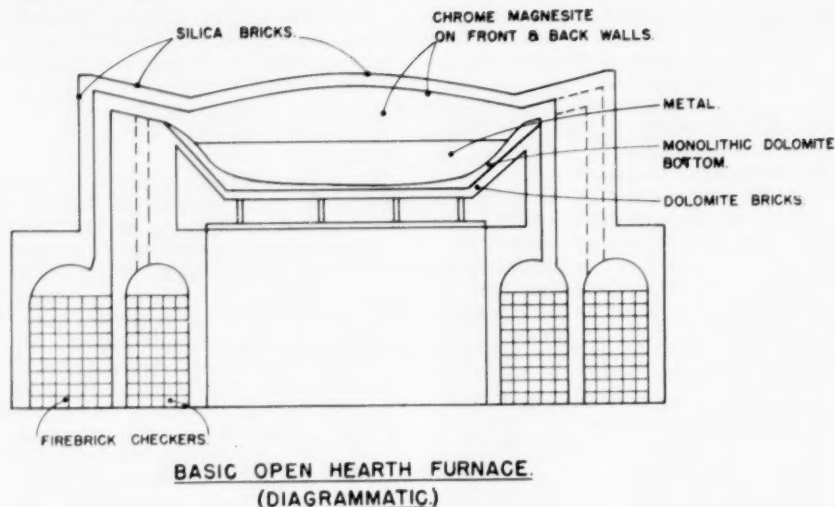


Fig. 2

The manganese combines with oxygen left in the metal to form an oxide which enters the slag above the metal, and the carbon supplies the necessary ingredient for the steel. The amount of carbon can be varied by the amount of ferro manganese added.

Open Hearth Process

The Bessemer process is a rapid one and capable of big outputs and this fact offsets the rapid wear on the refractories. The open hearth process, however, is able to deal with scrap metal and this is a great advantage. In addition the process is adapted for heat recuperation. In point of fact in 1946 about 89 per cent of the steel output of this country was made by the open hearth process, and of this 79 per cent. was made by the basic process.

A diagram of the open hearth furnace is given in Fig. 2. It consists essentially of a trough which can be heated by gas or fuel oil, the flames passing over the metal, and the heating being mainly by radiation from the roof. Under the melting hearth on either side are a system of recuperators by which the air required for combustion can be preheated and if producer gas is used, there is provision for preheating this, too. Fuel oil cannot be preheated on account of decom-

position of the hydrocarbons with deposition of carbon, which would clog the burners. These are located on on either side of the hearth and firing can be from either side alternatively. The preheated gas and air are burnt on one side and the products of combustion are taken down through the recuperators on the other side to heat them up. The recuperators are simply a checker work of bricks in a suitable container. When hot enough the firing is switched, and the gas and air passed through the hot checkers. The products of combustion are now taken into the recuperator in the other side of the hearth which had previously been used for preheating, and are now relatively cold. In this country increasing amounts of fuel oil are being used to heat open hearth furnaces. The high calorific value of the fuel means that the process can be speeded up and this to some extent offsets the higher price of the fuel. Moreover, it gives excellent control of heating.

Open hearth furnaces can be stationary or tilting. In the latter case they can be tilted about the horizontal axis. This simplifies pouring. An average size is about 100 tons capacity. Doors are provided in the furnace for charging fresh material. Scrap metal can be used in the open hearth process and the charge is usually a mixture of

pig iron, either molten from the blast furnace or cold, scrap iron or steel, iron ore, and lime. This is fed into the furnace by a special charging machine, which lifts the metal charge containers, inserts them in the furnace and then inverts them to drop in the charge.

Construction

Most of the steel made in this country is done by the basic process and it is proposed to describe that type of furnace. A note on the differences in the acid open hearth furnace will be given in a later section.

The furnace itself can be divided into the roof, side walls, hearth and gas ports.

The hearth is built up on steel plates which are sometimes covered with a layer of insulating brick. This reduces heat losses, but also increases the danger of molten metal penetrating

into the hearth bricks. Firebrick is then built upon this.

According to Dr. Chesters, open hearth furnaces are often constructed with 9-12 in. of basic bricks (three or four courses laid flat) with or without firebrick beneath. This refers to an 80-ton capacity furnace. The monolithic hearth is then made on the basic bricks and usually is at least 12 in. thick. Temperatures in the open hearth furnace approximate to 1,700° C., with severe slagging action and the presence of abrasive dust. The basic bottom bricks are of the magnesite type, typical details of which are given in Table 1.

It has been found in recent years that bricks made from a stabilised dolomite clinker, a cheaper material, can replace magnesite. Some details of this type of brick are given in Table 1. In some American furnaces chrome-magnesite bricks are used in place of

TABLE 1.
SOME CHARACTERISTICS OF BASIC REFRACTORIES.

1. Chemical Analysis (percentage)	Fired magnesite	Fired basic	Fired Chrome-magnesite
SiO ₂	2-3	2-3	4-6
TiO ₂	0-1	0-2	0-2
Fe ₂ O ₃	2-5	1-3	10-14
MnO	0-1	0-1	0-1
Al ₂ O ₃	1-3	1-3	14-20
CaO	1-2	48-50	1-2
MgO	85-90	36-40	38-40
Cr ₂ O ₃	—	—	28-30
2. Physical Properties			
True porosity (per cent.)	20-22	20-22	22-25
Apparent porosity (per cent.)	19-21	19-21	22-24
Bulk density	2-84	2-55	2-85
Specific gravity	3-55	3-35	3-80
Specific heat	0-225	0-25	0-2
Permeability	0-02	0-09	0-07
Cold crushing strength p.s.i.	+6,000	4,000-5,000	+3,000
Spalling index	4	+15	+30
After contraction			
(2 hours at 1,500° C.)	-0-2	0-1-0-3	Nil
Weight per c. ft. (lb.)	180	160	180
Weight per 1,000 bricks 9 in. x 4½ in. x 3 in. approx. (lb.)	12,000	11,500	13,000
Refractories under load 28 p.s.i.			
10° C./min. rise in temperature	1,650° C.	1,600° C.	1,750° C.
10 per cent. subsidence at			
Maintained ditto			
2 hours at 1,600° C.	3 per cent.	5 per cent.	5 per cent.
Percentage subsidence			

CERAMICS

magnesite in the furnace bottom as there is less risk of the bricks hydrating (with swelling) during shut-down periods. The hearth proper is rammed with a mixture of crushed dead-burned dolomite in this country. This is mixed with 5 per cent. of tar (water free) and rammed in with pneumatic rammers. The dolomite is calcined at 1,700° C., and in this condition resists hydration. Once ground it should be used quickly. The furnace is put to work as soon as possible and the hearth is slagged with several tons of slag to encourage sintering of the rammed material. Magnesite hearths sinter less readily and are usually burnt in, the magnesite being mixed with basic slag or mill scale to encourage this. With patching a hearth can be made to last for several years, some consider it better, however, to renew it every two or three years.

The Back Wall

This will have to stand similar conditions to the hearth and the action of the molten basic slag will be severe. Silica bricks have been used but in this country chrome-magnesite are now replacing them. Metal cased magnesite bricks are also used. The wall is

either vertical or sloped back. In the latter case it is fettled with dolomite or magnesite and this type of wall has a much longer life than the vertical. With a vertical wall the life in silica bricks is of the order of three weeks. For chrome-magnesite it is about thirteen weeks for a vertical wall and about twice that for a tilting furnace. Failure of chrome-magnesite bricks appears to be due to bursting, caused by solid solution of iron oxide in the chrome.

The Front Wall

The conditions here are similar to those of the back walls. The front wall contains the charging doors which may get knocked about by the charging machine. Chrome-magnesite bricks are used on most British installations as these have adequate resistance to slag attack and spalling. They suffer from the bursting noted above. Some works still use silica bricks for the front wall and extend the life by parging the inner surface with a chrome-magnesite cement. The doors need to be made of material which is resistant to repeated thermal shock and has sufficient refractoriness. Aluminous fireclays are used and

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trials with a brick based on china clay have given promising results. Silica bricks are used at times but then steps are taken to prevent thermal shock.

Door jambs and arches need frequent replacement. Doors are very vulnerable, and may not last more than 80 hours in some cases. Water cooling may extend the life to three weeks.

Dr. Chesters (*op. cit.*) suggests that the life of the front wall could well be improved by redesigning it. A sloping wall as for the back wall would improve matters, but if this proved impracticable he suggests that a panel construction as employed on boiler installations, held together by steel ties, might be an improvement.

The Roof

This is made of silica brick, and on most British plants the roof is 12 in. thick, though greater thicknesses are used in the United States. A life of from thirteen to twenty-six weeks is usual in this country, though shorter lives have been recorded. The silica brick possesses the advantage of being able to absorb relatively large amounts of iron oxide without serious lowering its refractoriness. In addition its refractoriness under load is high and above 600° C. its resistance to thermal shock is good.

Care is needed not to heat up too quickly until the temperature is over 600° C. as otherwise spalling may occur due to silica inversions. The German specifications for silica bricks for open hearth furnaces give the following requirements:

1. Analysis: SiO_2 not less than 94.5 per cent.; Al_2O_3 not more than 2.0 per cent.; CaO not more than 3.5 per cent.
2. Refractoriness: at least Seger cone 32 (1,710° C.)
3. Refractoriness under load (2 kg./sq. cm.): failure not to begin below 1,630° C.
4. Total porosity: less than 25 per cent.
5. Specific gravity: less than 2.43.
6. Cold crushing strength: Over 100 kg./sq. cm.

Dr. Chesters prefers specific gravity to be not over 2.38 and the average of

a consignment to be less than 2.36. The lime content should be less than 2.5 per cent. He points out that even this is rather high and that improved results are obtained with bricks made without lime at all.

A minimum melting point of 1,710° C. is desirable and a bulk density of 1.70 gm. per c.c. A good brick should stand 1,600° C. under a load of 25 lb. per sq. in. for at least an hour. After expansion should be small. This arises from residual quartz in the silica brick and can be checked by specific gravity determinations used as a control on the manufacture. It has long been realised that if the temperature of the open hearth furnace could be raised another 100° C. or less considerable economies in manufacture would result. The present limiting factor is the roof. A measure of success has been obtained in this country with chrome-magnesite roof bricks and with magnesite in Germany. Due to the much greater expansion of chrome-magnesite over silica many constructional problems have had to be overcome. The problems of bursting and spalling of basic refractories still remain, however. If these could be solved the way to universal adoption of the all-basic furnace would be open, with all its attendant advantages.

The Gas Ports

These have to withstand the high temperature of the furnace and are subject to much abrasion by iron oxide and lime dust. Water-cooled chrome-magnesite is commonly used and lasts for the normal campaign life of the furnace.

The Checkers

The purpose of these is to recuperate heat. The problems that arise are the same as those noted in the previous article for the stoves of a blast furnace and the materials used are similar. It is, therefore, unnecessary to elaborate these further.

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Ultrasonic Machining of Ceramics

by

THOMAS A. DICKINSON

PLATE GLASS, quartz, pottery, ceramics, and many related materials are now being machined to close dimensional tolerances like metals at Reinhold-Geiger Inc., Los Angeles.

The process involves use of a new machine tool known as the Sheffield Cavitron, basic function of which is to convert radio-frequency current (derived from a standard alternating power circuit) into ultrasonics (sound waves pitched so high you cannot hear them) by means of a magnetostrictive transducer.

Curiously enough, the Cavitron is not nearly as effective as conventional machine tools where it is necessary to process relatively soft materials like copper and aluminium; yet it does things that could not be done with the best of available diamond cutting tools when it becomes necessary to machine substances with very hard surfaces. In fact, its efficiency in any given circumstance is

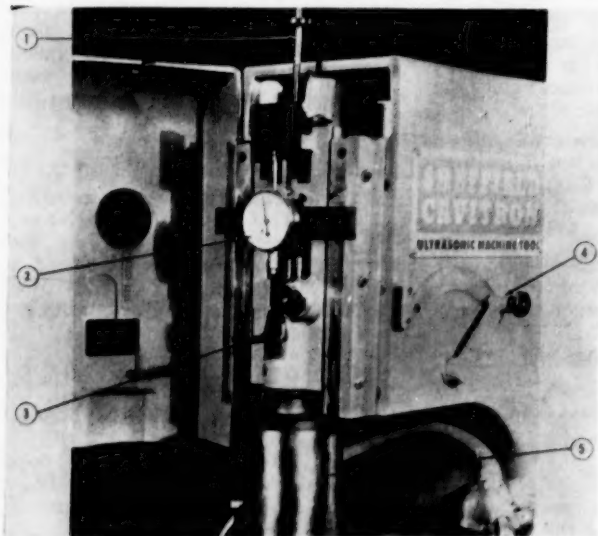
proportional to a workpiece's hardness.

Design of Tool

In essence, the Cavitron's transducer is nothing more than a coil with a ferrous core. Due to the phenomenon of magnetostriction, the core expands and contracts about 25,000-30,000 times per second when the coil is being energised with oscillating current.

Vibrational frequencies of the transducer are varied in accordance with the acoustical properties of materials being processed by means of electronic controls, which are very similar to the controls used in operating radio transmitters and receivers.

The ultrasonic output of the transducer is transmitted to a cutting tool by means of a tool holder which is removably attached to the transducer's core. Result of this is a tool working stroke on the order of 0.003 in.



Pictured here are the transducer components which permit use of the gravity feed principle in operating the Sheffield Cavitron. (1) Counterbalance weight support. (2) Slide feed indicator. (3) Feed adjustment weight support. (4) Transducer throw-off lever. (5) Transducer.

The Cavatron's cutting tool is aligned with a new workpiece prior to an ultrasonic machining process. Note the two flexible metal tubes through which abrasive is pumped into the space between the cutting tool and the workpiece



Because actual cutting is done by the edges of abrasive grains flowing between a tool and workpiece, the cutting tools are usually blunt devices similar to coining or embossing dies. They are made from monel metal, stainless steels, molybdenum steels, and other materials which are appreciably softer than the substances being machined because soft surfaces are not as susceptible as hard surfaces to abrasive action.

Efficiency of Tool

The lifespan of the cutting tools is not great (being limited to the production of about fifty parts per tool where no close tolerances are required). However, the tools are inexpensive and can be replaced at a moderate cost (since they are merely brazed or silver-soldered to their holders).

Abrasives used by Reinhold-Geiger for ultrasonic machine work are boron carbide materials in the 240-800 grit range. They make it possible to maintain tolerances of ± 0.002 in. to ± 0.0005 in.—depending, of course, on the magnitude of the abrasive particles in each circumstance. They are dispersed in water, rather than in oil, because intense sound waves cause oil to foam.

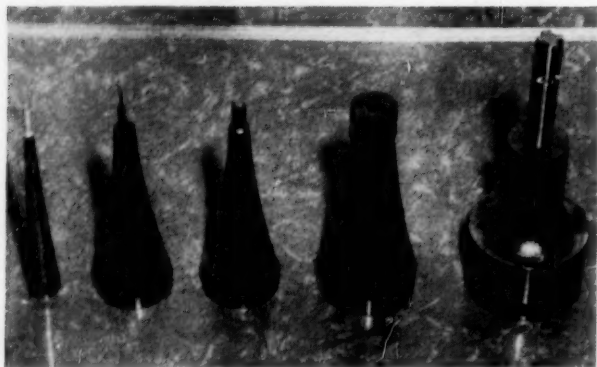
Since the vibrations of an ultrasonic cutting tool represent "acceleration without motion," there is no tendency on the part of the tool to displace a workpiece; and, in some instances, materials can be satisfactorily machined without being clamped to the work table. However, a cutting tool and workpiece must be carefully aligned and held if close dimensional tolerances are to be maintained.

Reference surfaces on a fixture holding a workpiece are usually such that they can be aligned with reference surfaces on a tool; and, if reference surfaces are not incorporated in the shape of a tool, the tool shank is referenced with flats.

Rotary alignment requirements are met by a worm and worm wheel adjustment in the transducer slide, while longitudinal and cross-slide adjustments are provided in the machine's work table.

Operating the Cavatron

The gravity principle of feeding is employed in operating the Cavatron. This involves the use of weights to overbalance a counterweight in the transducer's slide column, and it allows a cutting tool to progress as rapidly as an abrasive solution is capable of removing material from a workpiece.



Typical Cavitron cutting tools, brazed to the tapered upper ends of appropriate tool holders

The abrasive fluid is pumped through the work area via a pair of flexible metal tubes, and where shallow cavities are produced the vibrations of the cutting tool allow adequate quantities of the solution to get between the tool and the workpiece. Where deep or intricate cuts are made, one or more of the following methods can be used to get a sufficient quantity of abrasive into the cavities:

(1) A tool holder with an internal abrasive feed may be employed so that the solution will flow through the tool as well as through the external tubes.

(2) A special fixture may be used to apply an oscillating motion to the workpiece, thus facilitating the flow of abrasive into the cutting zone.

(3) The workpiece may be pre-cored with holes to allow the abrasive to flow into and out of the cutting area.

(4) The outside periphery of the cutting tool may be spirally grooved so as to improve the flow of fluid into the cutting zone.

(5) The shank of the tool back of the full form may be relieved to provide additional clearance for the abrasive solution.

Scope of Tool

Largest of the cuts that have thus far been produced with Reinhold-Geiger's Cavitron covered two surface inches. However, it is at least theoretically possible for the new tool to machine an area comprising as many as three surface inches.

Smallest of the cuts that have been made to date are 0.0001 in. dia. holes. Their production involved the use of a steel needle from an ordinary hypodermic syringe as a cutting tool.

As previously intimated, the time that is required to produce a given cut depends not so much on the size of a cutting tool or the area being machined

as on the hardness of a workpiece. For example, a cutting tool capable of producing a $\frac{1}{8}$ -in. square hole will penetrate a $\frac{1}{8}$ in. layer of carballoy in 21 min. and a $\frac{1}{8}$ in. layer of glass in only 7 min. because glass is approximately three times as hard as carballoy.

In production work, the reciprocating nature of ultrasonic machining has been especially advantageous because it permitted the use of multiple-element tooling. For example, in the manufacture of special ceramic spacers for electronic tubes, six small holes have been precision drilled around the perimeter of a rectangular hole in the centre of each part by means of an ultrasonic cutting tool comprising six steel pins brazed to a hexagonal mild steel plate.

A rectangular stud in the centre of the latter tool served as a locator for the hole in the centre of each part; and, after about a hundred of the spacer blanks were cemented to a glass plate for production purposes, the parts were drilled at the rate of about one every 30 seconds.

Other Applications

Cavitron facilities have further made it possible to gang slice germanium, sapphire, and quartz into the thin wafers that are used in the production of transistors, jewel bearings, and crystal oscillators. This is important because such parts once had to be fabricated individually at a terrific cost in terms of both time and wasted materials.

A tool for the gang slicing of quartz and sapphire has been made simply by brazing a parallel array of thin steel or molybdenum blades to the face of a tool holder. Due to the close spacing of the blades, wafers with 0.015 in. thicknesses were subsequently produced. Apart from the fact that they were much thinner than similar parts normally produced with diamond cutters, these wafers were free

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from saw marks and looked as if they had been lapped.

Another tool, used in gang cutting germanium, comprised 0.005 in.-thick strips of steel which were interleaved like the paper packaging components of an egg crate and then brazed. It produced up to 100 transistor blanks every 6-8 sec.

Quantities of scrap produced during ultrasonic gang cutting operations are relatively small, since only molecular particles are chipped away in areas of extreme thinness.

For Decorating Glass

Numerals, letters, and lines have been ultrasonically cut on glass and other hard-surfaced materials in a fractional period of time by using etched metal plates as guiding tools.

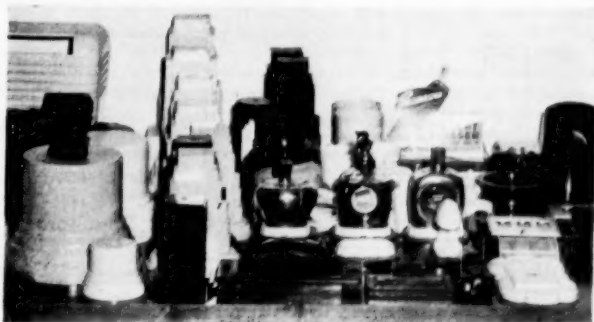
Holes in ceramic workpieces can be tapped with the Cavitron. This involves the use of the threaded portion of a standard steel screw as a cutting tool.

The size of the screw is such that grit can be readily displaced during tapping operations, and the work is held in a threaded adapter which has the same lead as the screw so that it can be manually moved upward on a spiral as the tool feeds into the work.

Probably the most unusual use that has been found for the Cavitron consists of producing curved holes. The holes may have any desired shape, and their axes may be curved to any degree—including right-angles. Their production is practical because the ultrasonic output of the Cavitron will follow the curve of a bent cutting tool—thus driving the tool into a workpiece in the direction of the curve.

Materials being machined with ultrasonics are subjected to very low stresses and virtually no local heating. Consequently, they undergo no chemical change, decomposition, or alteration of physical properties.

Some of the products which have been made with the aid of the Sheffield Cavitron



Automatic Control of Molten Glass Level

A NEW DEVELOPMENT

IN the manufacture of glassware using a continuous process, the maintenance of a steady "metal" level in the glass-melting tank is important if consistency in capacity and weight of finished product is to be attained.

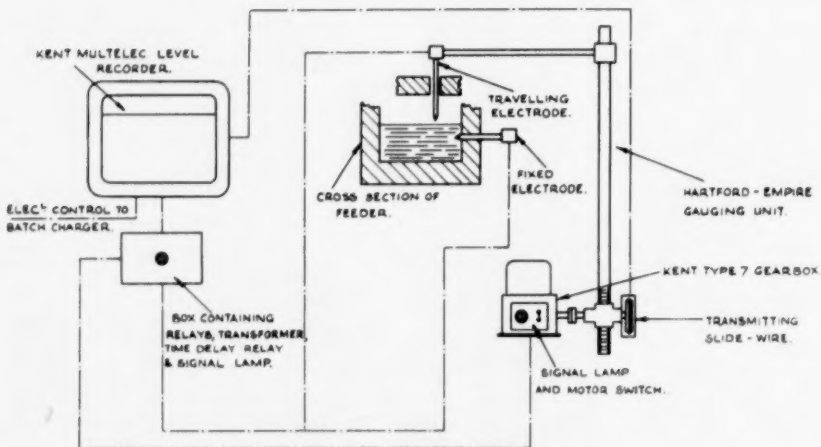
A system of level measurement is now available, manufactured by the Hartford-Empire Co. and George Kent Ltd., which is capable of detecting and recording changes of level of a few thousandths of an inch and yet is constructed to meet the severe conditions associated with glass manufacture.

Explanation of Mechanism

As illustrated in Fig. 1, a stationary electrode is immersed in the glass in the forehearth of one of the feeders, while a travelling electrode is raised and lowered by a motor-driven gearbox. An electrical transmitter geared to the travelling electrode sends signals to the receiver of the recorder, indicating the electrode's position. The two electrodes are ener-

gised by a low-voltage A.C. supply, so that when the travelling electrode is raised and then lowered to the point where its tip touches the glass surface, the electrical circuit is completed, energising a time-delay relay, which causes the travelling electrode to be held stationary for a few seconds, while the Multelec recorder mechanism is switched into operation. After the recording has been made, the geared drive is reversed, raising the travelling electrode to the point where it breaks contact with the glass surface. The drive is then immediately reversed once more and the electrode lowered to commence a new cycle.

An indicator lamp lights each time the travelling electrode is in contact with the glass surface, and besides indicating that normal recording is proceeding, this feature may be used as a means of indicating the position of the glass level if continuous recording is not required. The procedure is to lower the travelling



DIAGRAMMATIC SCHEME OF AUTOMATIC MEASUREMENT OF GLASS LEVEL.

Fig. 1

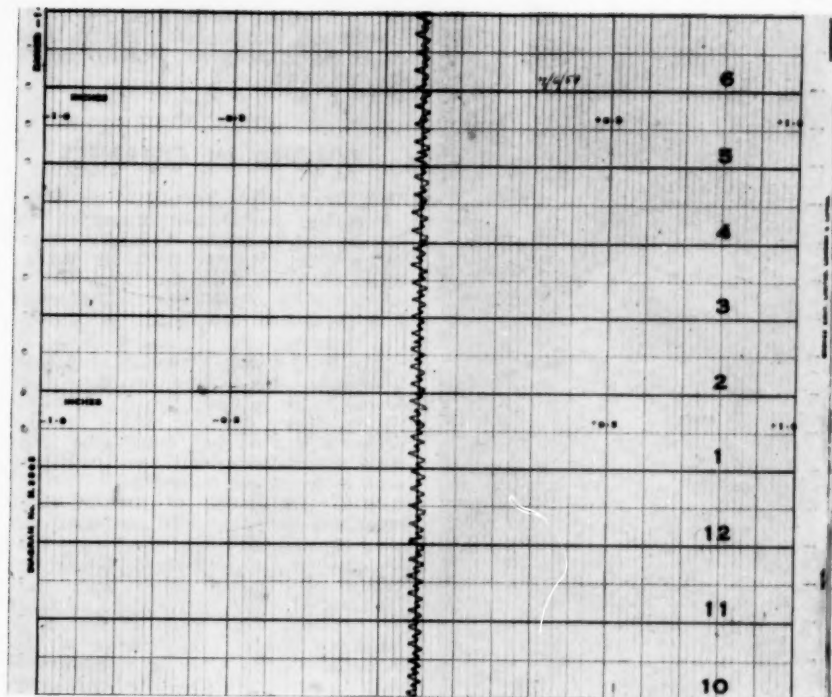


Fig. 2

electrode by means of a handwheel until the lamp lights, and the level is then read off on an engraved scale.

Additional features include an alarm to call attention to a breakdown in the recording cycle, adjustable high- and low-level alarm contacts, a magnetically braked motor drive eliminating overdrive of the travelling electrode, and a safety clutch.

Control of Level

Automatic control of glass "metal" level by regulation of the rate of batch charging follows naturally on the recording of level changes. It is effected by adding to the recording mechanism already described, a mechanism to vary the rate of charging by the batch chargers.

For a continuously running screw-type charger, in which the speed of rotation of the screw feeding the batch into the furnace is varied, the Multelec recorder is fitted with a Mark 20 pneumatic controller. A power cylinder is used to operate the existing speed regulator of the variable-speed driving mechanism.

For pusher-type chargers, which run to a predetermined cycle fixed by electrical timers operating the starters of the charger motors, it is simply necessary to

initiate the cycle as often as required to maintain the correct level. For this purpose, the Multelec is equipped for "on-off" control.

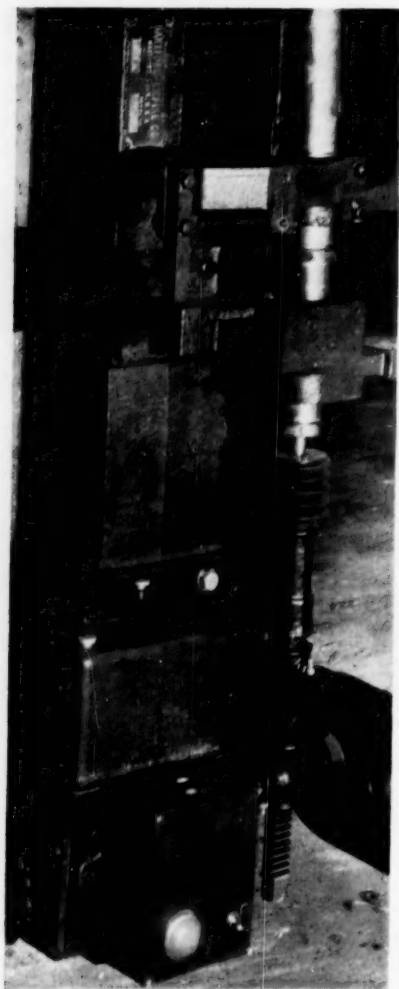
Fig. 2 is a typical chart record of level obtained using this system of glass-level control at the works of Jackson Bros. (of Knottingley) Ltd.

Pressure Control Essential

Close control of tank pressure is essential, because changes in tank pressure directly affect the "metal" level in the forehearth, quite apart from their effect on combustion in the tank.

To illustrate this point, the plant may be considered as a manometer, one leg of which is the tank, subjected to furnace pressure, and the other the combined forehearth, which are open to atmosphere. Increase in tank pressure will cause an increase in glass level in the forehearth. Moreover, owing to the difference in surface area of the two "legs," any change of level in the tank will be magnified, possibly as much as ten times, in the forehearth.

The glass-level control equipment has been designed by George Kent Ltd. in conjunction with the Hartford-Empire Co., and special provision has been made



for the coupling of the Kent and Hartford-Empire components. Fig. 3 (left) shows the motor-driven gearbox end of the equipment.

COLOUR IN CERAMICS

TO an overflow meeting of the Manchester and District Branch of the Design and Industries Association Luncheon Club, Mr. A. B. Read, R.D.I., director of design for the Carter Group of Companies, Poole, Dorset, gave an intimate and interesting talk on "Colour in Ceramics."

Mr. Read said that the craft of making utensils and tiles in fired clay was almost as old as the history of man. At many periods during this long history, ceramic products had reached remarkable standards of craftsmanship with excellence both in design and technique.

With the coming of the industrial revolution of the 19th century, the level of design fell and industry was able to produce or reproduce the entire gamut of classical forms with such facility that whole interiors and exteriors of buildings were made in glazed or unglazed faience. The interior of the National Liberal Club in London was such an example—technically remarkable but aesthetically horrifying.

Within the last few years there had been an interesting revival in the use of tiles and faience for buildings of all kinds. The growing awareness of good design, good colour and the appropriate uses of building materials had enabled the architect to use tiles and faience to give permanent colour and pattern where needed. Screen printing had provided an effective and comparatively simple method of producing a patterned tile unit in a great variety of colours and this unit or combination of repeating units was a new and exciting element in architecture.

External walls, internal surfaces, fireplaces and bathrooms could be clad with patterns as gay as those developed for textiles. In schools and commercial buildings, the patterned tile was providing hygienic, durable and colourful finish for wall surfaces and the design of both units and areas had attracted the attention of first-rate designers and artists.

Interest in this new development was universal and there was no doubt that it clearly indicated a revival of an old craft after a long period of "porridgy" stagnation. "One hopes that the buff, oatmeal coloured and 'mottled' tiles are fast going to be replaced with coloured pattern of a high and exciting design standard," Mr. Read concluded.

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A Visit to Delft

by GILLIAN GRAIG

THE factory of De Porceleynse Fles at Delft is a model of Dutch diligence and efficiency. Last year the pottery celebrated a record of three hundred years of uninterrupted production; today the sound of hammering can be heard everywhere inside as the premises are being enlarged to make way for even greater production. There can be no more substantial proof of success. Owing to the great development in the production of architectural features of all kinds and the growth of a department specialising in refractory materials the pottery now employs several hundred people, but artware remains the speciality and it is for the consistently fine quality of design and colour that Delftware is known throughout the world.

The pottery—the only remaining one in Delft—lies on the outskirts of the old market town amongst a cluster of more recent industrial enterprises. The entrance hall is a showroom in itself as the floor, walls, and impressive central staircase are constructed entirely of multi-coloured tiles made by the pottery. The showrooms, which are also being enlarged to make room for the display of architectural features, testify to the great diversity of products which this pottery is turning out.

Characteristic Delftware

A cabinet display of old Delftware which was originally part of a collection belonging to William III of the Netherlands contains some beautiful examples of the original 17th-century blue Delftware. Here, by comparison of old and new ware, the difference in design and technique can be fully appreciated. The old blue is characterised by an on-glaze decoration painted on top of an opaque tin-enamel glaze which provided the necessary white background. The new ware is decorated under-glaze on a



Red, blue and gold Delftware

hard white biscuit which is fired at a high temperature and is therefore less fragile. The transparent coating of glaze which is applied subsequently adds to the beauty of decoration and protects it from wear. Contemporary examples of Red, Blue and Gold ware show a combination of both techniques in that the blue is applied under-glaze and the red and gold on-glaze.

In design and decoration most of the contemporary ware remains true to the style which may be called characteristically 'Delft'. Chinese, Japanese and Italian influences are still apparent in many of the floral and animal motifs and the emphasis is more upon formal decoration than upon abstract experimentation. Conventional designs maintain a fresh appeal through re-interpretation and development by individual artists in their own style. Present-day blue ware still shows traces of Chinese motifs introduced in the 17th century, and the ware known as Red, Blue and Gold owes its

CERAMICS

popularity to the fact that it is a reproduction of the Dutch Pijnacker ware of the same period. The new Delft and Lustre wares include a wide range of vases, plates, and bowls in which naturalistic and heraldic designs predominate.

Recent Glazing Developments

Scientific developments in the technique of glazing have resulted in two outstanding types of ware which deserve mention on account of their colouring. One is characterised by an all-black decoration applied under a beautiful turquoise glaze; the other, known as *Reflet Métallique*, is a product of the interaction of different glazes at a high temperature giving rise to a metallic surface of merging colours. The impressionistic effect of this type of ware is in direct contrast to the detailed work which is to be found on every piece of blue Delftware. Delft's most recent product, *Decorated Craquelé*, which consists of a red decoration on a white background, is another example of the use of scientific knowledge in the behaviour of glazes during firing. A glaze with a larger thermal expansion than the body is deliberately used in order to produce

a fine network of surface crazing. Another fairly recent product is the undecorated *White Delftware* which achieved instant success on account of originality in shape and fine quality glaze.

Crystal glazes have also played a large part in the development of the *cloisonné* technique for ornamental plaques which this pottery has achieved to perfection. In this technique the plaques have a sculptured effect as the dividing lines between different colours are accentuated by raised contours of clay. The possibilities for design are limitless and the present range includes bird and animal figures, miniature landscapes, and heraldic crests.

For Architectural Decoration

In the field of architectural products *De Porcelayne Fles* has for a long time made ornamental tiles and panels for both interior and exterior decoration. A tiling technique has been evolved which in its relief aspects may be compared with that of the *cloisonné*. Known as the *sectile* technique it involves the use of tile fragments instead of square tiles to build up the various sections of a design which are often delineated by raised outlines. Many artists have been attracted towards this medium by the greater depth and variation of colours made possible by the development of crystal glazes. Some of the finest artistic achievements are to be found in the ecclesiastical works which are of particular interest in demonstrating the importance of improved techniques to the realisation of works of an æsthetic quality.

To meet the increasing demand for glazed wall and floor tilings of a more utilitarian nature for public buildings and private houses the pottery makes uniform and multi-coloured tiles in a wide range of pleasing colours.

Within the Pottery

A tour of the pottery itself reveals the products in the various stages of their making. The workers at Delft are proud of the fact that every single process including shaping, decorating, and glazing is still carried out by hand. Only in the tile and refractory departments can anything mechanical be seen. Tiles are made by the usual method of pressing in steel dies.



Large jar in royal blue Delftware

Throwing and Moulding

In the throwing and moulding department various methods are used for shaping the clay according to the nature of the article to be produced. Amphora-shaped vases, for example, are cast in the ordinary way in plaster casts, whereas ornamental plates are made by jollying. The chief thrower at Delft is highly skilled and gives a pleasing demonstration of his ability. Taking a ball of clay and setting his wheel in motion, he can fashion a series of at least ten different shapes in succession at the speed of approximately one a minute. A narrow-necked wine bottle is transformed finally into a wide shallow bowl and the wheel kept rotating throughout. The clay used is a fine white kaolin with a high degree of plasticity. All the clay used in the pottery is imported, most of it coming from this country.

Firing

After drying the articles are fired at a high temperature and this yields a hard white biscuit ready for decorating. The colour of blue Delftware only becomes apparent in the glaze fire, and the actual painting is carried out in various shades of grey and black. For this reason it is a highly skilled occupation. Glazing of the decorated articles is done by hand-dipping and any uncovered surfaces are touched up subsequently by brush. After glazing the articles are ready for the second firing. The kilns are coal-fired and of the tunnel type. Owing to the high price of town gas, coal is still found to be the most economical type of fuel. It is possible that recent finds of oil between the Hague and Delft might justify the capital expenditure of a change-over in the future to the use of oil, should it ever be made available at a sufficiently low price. The ware is fired for thirty-six hours at 1,100° C. and is carried through the kiln by cars loaded with saggars. Blue Delftware is fired in a separate kiln from other types of ware.

High Proficiency of Artists

The seventy artists and apprentice painters employed by De Porceleyne Fles work in a group of studios upstairs. They are nearly all young men

who are graduates of art schools and universities, many of whom trained at the technical school in Delft itself. The pottery lost many of its artists in the war, and the predominance today of those from the younger age-group is an inevitable result. Every piece of Delftware is painted by hand. This not only ensures results that are aesthetically pleasing but is in keeping with an old Delft tradition. The artists have attained such a high degree of skill that they are able to reproduce works of the old masters in blue Delftware with exactly corresponding depths and gradations of colour. The portraits and landscapes of 17th-century painters which appear as panels and plaques are even more popular than those of contemporary design. In spite of the fact that this seems to reflect a national preference for the traditional in purely ornamental ware, many of the contemporary designs at Delft are exceptionally fine.



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The Morgan Crucible Co. Ltd.

A New Central Research Department

THE MORGAN CRUCIBLE CO. LTD. echo a general belief that if this country is to improve or indeed maintain its present standard of living, its industries must be able to compete with the world's best in terms of quality and cost and to do this it must, as far as industry is concerned, improve administration and management, recognise the value and place of the technician, make faster use of advances in technology, whilst fostering industrial research works as an increasingly important foundation to industrial progress.

With these aims in view, the company planned its post-war research activities. The Morgan Crucible Co. Ltd. is essentially a piece-part maker, supplying engineering components to other process or engineering industries and though many of them are manufacturers of consumer goods whose names are household words, others are themselves still a stage removed from direct contact with the man in the street.

The company originated in Battersea some 100 years ago, making clay-bonded plumbago (natural graphite) crucibles for mines, refineries and foundries. This was quickly followed by refractories in the shape of clay and magnesite assay ware—crucibles, muffles, cupels, etc., after which the company gradually widened its interests into fields associated either through common raw materials, similar processing or associated fields of application. Today's manufactures are as follows: plumbago crucibles, refractories, carbon brushes for electrical machines, carbon specialities, sintered metal products, lighting and welding carbons, carbon and graphite paints, greases and lubricants, chemical carbon and graphite, radio and electronic components, silicon carbide heater rods.

Central Research Department

The Central Research Department has in effect existed for many years in the shape of departmental research, central analytical laboratories and personal co-ordination of technical effort at higher staff levels. It was only post-war that it was decided to rationalise and strengthen these activities and to set up at Battersea

a Central Research Department, itself responsible, through a general manager, to a director.

It was considered that the nature of the work, with its combination of craftsmanship and detailed knowledge, demanded that the advantages of empirical or trial-and-error development be fully retained and that, dependent as they were upon the intuitions and knowledge of experienced technicians in day-to-day contact with the shop floor, process and product control and development must remain departmental.

This left the roles of the Central Research Department clear, viz.: to ascertain facts; fill in background; centralise specialised equipment and specialists in its use; co-ordinate and cross fertilise technical thought and experience; create new ideas and develop them to the pilot plant stage, when they do not clearly lie in the field of any existing department.

Additionally, it was decided that the Central Research Department could beneficially lease space and services and generally act as landlord to departmental technical workshops.

To meet these aims a C.R.D. organisational set-up was evolved as follows:

Research Group

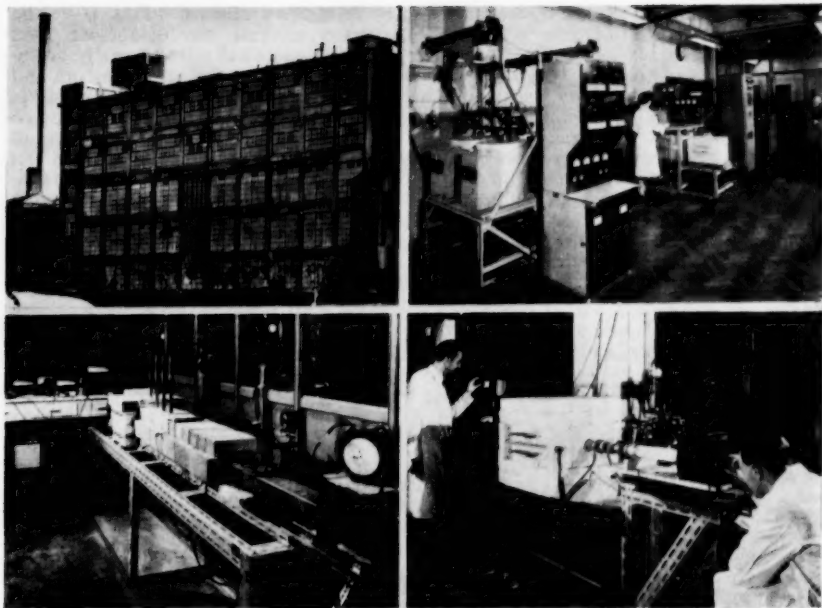
The work of the Research Group derives from three main sources: (a) the technical committees of the various company manufacturing groups; (b) research and development contracts, from external bodies such as the Ministry of Supply; and (c) from the Central Research Department itself.

The first group accounts for about 55 per cent. of the available effort, the second about 20 per cent. and the last about 10 per cent.; the remaining 15 per cent., as already noted, is utilised in day-to-day consultative services and "ad hoc" assistance to the various company development departments.

The group is divided into the following sections: chemistry, high-temperature chemistry, physics, mathematics and bench pilot-plant.

Engineering Group

The Methods Engineering Section of this Group has three main functions:



(Top, left) An exterior view of the department; (Top, right) Equipment for testing mechanical strength at high temperatures; (Bottom, left) An experimental tunnel kiln; and (Bottom, right) A test furnace comprising Morgan M.I.28 bricks and Crusilite heater elements for high temperature chemistry research

- (a) To satisfy the demands of the C.R.D. for all kinds of mechanical and electrical devices ranging from "sealing wax and string" to precision work of the highest accuracy.
- (b) To investigate any production problem arising in any of the company's manufacturing groups. This may involve a simple jig modification, a prototype machine up to medium size or in a few cases a recommendation on change of layout.
- (c) To keep abreast of and be prepared to advise on the latest production engineering techniques.

The Instrument Section of the Group is in three divisions:

- (a) Instrument repairing and servicing (ammeters, volt meters, etc.).
- (b) Pyrometry, which covers installation and servicing of all temperature measurement instruments and the running of special tests when required. The pyrometry service is run on a "territorial" basis. Each engineer has a given "territory" and he is responsible for the instruments in that area. Checks are taken at fixed intervals and recorded on a card, one card for each instrument.
- (c) Electronics, including design, making and servicing of all types of electronic

equipment. This is a field which is being intensively explored and more uses are constantly being found for this revolutionary technique.

There is a well-equipped standards room which includes such equipment as bridges, standard lamps and a dead weight tester for pressure gauge checking.

The Experimental Kilns Section is staffed by practical experienced kiln burners working under the administrative control of the Engineering Group, but under the direct technical control of section leaders in the Research Group.

This section has the following functions:

- (a) Testing the company's refractories under actual service conditions as distinct from conditions as simulated on a laboratory bench.
- (b) Evolving new designs of kilns.
- (c) Carrying out production trials on new kiln processes or on ware requiring new firing techniques to improve their quality.

Scientific Services Group

The work of the Analytical Chemistry Laboratory, incorporated in this Group, falls into three main parts:

- (a) Routine or semi-routine analyses as an aid to process control.
- (b) Non-routine investigations on samples from all sources.

CERAMICS

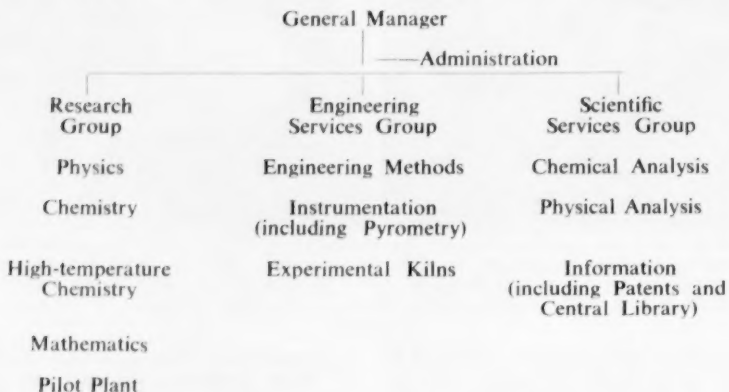
(c) The development of new methods and the investigation of new analytical techniques.

The Physical Analysis Laboratory is concerned with the examination of materials and products of physical methods, the main methods in general use being microscopy, spectrography and X-ray diffraction. Other methods of less general application such as differential thermal analysis are also used.

The work falls into the same three main sections as in the Analytical Laboratory, but with a greater emphasis

on research problems. This is to be expected in that the equipment used comprises essential research tools necessary to the elucidation of the nature and constitution of the materials and products of research. Valuable service is rendered to the process control departments, in particular by the spectrograph which can quickly detect and identify small quantities of materials, and by X-ray diffraction which can throw light on the complex changes which may take place in manufacturing processes or to a product in service.

ORGANISATION OF CENTRAL RESEARCH DEPARTMENT



(The general manager is directly responsible to a member of the board of the parent company, who himself takes a lively interest in the activities of the Department.)



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A Personal Impression

by W. F. COXON, Ph.D., M.Sc.

THE engineer deals invariably with a raw material such as metal, and most metals and alloys are capable of examination to show quite clearly their crystalline and even atomic structure. The reasons why they behave under certain physical conditions such as temperature, stress, etc., are capable of a scientific explanation. In short, the engineer in metal works with a material of which the fundamental scientific considerations are well known.

But the ceramic engineer is in a different category. His raw material is clay, or clay-like substances. In spite of the fact that in one form or another clay is the foundation upon which most civilisations are built—and one always feels that the analogy of the elephant's feet is a trifle outmoded—nevertheless fundamental information about clay, its properties, its behaviour, its crystalline structure, is still somewhat obscure. Thus the ceramic engineer is handicapped from the beginning in dealing with a raw material upon which his whole practical knowledge is almost entirely empirical. Past experience has shown him that if he can select his raw material to conform with some empirical test, and if this is mixed and dried to the green state in a manner again determined by certain empirical tests, and if this is ultimately fired on a close, time/temperature schedule, also determined by empirical tests, he will be able to obtain a uniform product.

Thus the science of production control to the ceramic engineer is largely a matter of empiricism.

It is important to bear this in mind when considering the work done in a research department such as The Morgan Crucible Co. The fundamental overriding principle is a close practical control of all production schedules, not so much based upon scientific considerations of the raw material, but upon past experience to maintain rigid production schedule conditions.

Thus many of the basic criteria which can be taken for granted by the engineer in metals and are universally applicable from process to process, from factory to factory, do not apply in the case of the ceramic engineer.

The visitor to the Research Department at Morgan's is thus impressed with the

great attention to detail which is carried out by a mixed bag of scientists and technicians, some of whom have come from the works to the laboratory and others from the universities to the laboratory, work together in a common interest.

Even the apparatus which they use has invariably been designed by themselves to help themselves, for unfortunately for them there was nowhere else to go. The result is that invariably the apparatus is simple in design. Instances are a thermal shock test for crucibles, simulating a hot crucible being placed on a cold, draughty factory floor; a simple balance arrangement to study the rate of oxidation of graphite; a multiple test bed for studying creep at high temperatures. Pioneering work is going on on cermets—composition of both metals and ceramic materials.

Undoubtedly in the production of ceramics the need for a large organisation ranging from semi-production furnaces and kilns right through the gamut of an engineering workshop, with support from analytical and physical chemistry laboratories, together with a strong background of examination by spectrographic X-ray diffusion and other tools of the physicist, is an essential to produce uniformity.

One came away from a visit to this large six-storey building devoted entirely to development and research towards increased consumer service, with an impression that there are few products in the ceramic field backed by such a vast resource. One cannot help feeling that one of the most potent weapons in the hands of the Morgan salesmen is this high-powered technical background which will impress any visitor who has the time to see around it.

Schoolgirls as Potters.—English slip ware is being made by girls of the sixth form at Northgate School for Girls, Ipswich, Suffolk, and has recently been on show at Foyles Gallery, London.

The 16-18 year old girls are being taught by Miss Dorothy Kemp, of Felixstowe, one of the leading exponents in the craft of pottery in Great Britain, and whose book *English Slip Ware* has recently been published by Faber and Faber.

Pountney's of Bristol

by a "Ceramics" Correspondent

AT Bristol, "the birthplace of English porcelain," sanitary ware to meet the needs of the housing drive accounts for 50 per cent. of the output of the Pountney Pottery at the present time, and yet production cannot keep pace with demand.

Although the Bristol Pottery is the oldest tableware factory in Britain, its layout and equipment are modern, enabling it to take its place among the Staffordshire commercials in the production of domestic table and toilet ware on a large scale for hospitals and institutions, as well as sanitary earthenware.

Pre-war Tunnel Kiln

In 1938 Pountney's installed one of the first tunnel kilns for glazed ware, and they recently built another electrically-fired tunnel to deal specially with sanitary ware.

They have kept abreast of modern interior decoration, and while the ware produced by the existing firm is in many ways different from that of the past it maintains both in originality and quality the traditions which have earned for Bristol a good name in the pottery world. The local hand-painted patterns for which Bristol was famous in the 17th century continue to make a wide appeal both at home and in America; their popularity in fact is so great that orders have been in arrears ever since the war. Prior to the lifting of restrictions the company enjoyed a considerable export trade, but a percentage of this has now had to be sacrificed in order to meet growing demands at home.

"Retailers would buy much more of our better class stuff if they could get it fast enough" says Mr. W. G. Cottrell, the managing director. Mr. Cottrell thinks that while the public's

taste in pottery is improving, there are still many people who have no wish to depart from the styles and patterns that were fashionable 25 years ago. One of their exclusive selling lines at the moment is the well-known "Budding Bough" design a very modern form of foliage decoration executed by silk screen litho, and band and line.

Extent of Market

Pountney ware is sold in most towns of the west and south of England, and firm markets have also been established in New Zealand and Australia and South Africa, and, to a lesser extent, in South America (particularly Uruguay) and Canada.

Like many other factories outside Staffordshire, Bristol suffers from a dearth of skilled workers in the trade, and this is attributed to the availability of other and probably more lucrative employment which is open to both men and women in the locality. Their difficulty is in building up a trained personnel—young people who will settle down in the trade and stick to it after they have become proficient. The prospect of having to do their national service at the age of eighteen has an unsettling effect on the boys, while most of the girls, says a spokesman of the company, seem to want to become shorthand typists. The result is that in the course of a year there is a 43 per cent. turnover among the young employees.

Design of Factory

Occupying an area of 21 acres, every process at the factory is operated on the ground floor. From the rough clay to the finished pot every department has been planned on the straight line. Workshops are lofty and airy,



A typical example of coloured Bristol kitchen ware

and, of course, the latest apparatus is used to counteract and remove the effects of dust. Before the last war 700 people were employed there, and it is hoped that this number will soon be reached again. Many of the older workmen have been with the firm all their working lives, and many of them are descendants of a long line of potters.

Pountney's do not claim to be on a par commercially with the "Big Five," but they are proud to remind their rivals that Bristol has been a pottery centre for as far back as can be traced, and many famous potters—among them Raby, the greatest modeller of his time—worked there round about the 1840's.

A Potted History

No story of the Bristol Pottery would be complete without a word or two about its history. It traces its origin back to 1652, though it was not until 1813 that a Pountney appeared in the title, but long before then Bristol waterways maintained a thriving

inland trade, and its pottery was in great demand. Many a handsome ship was painted on Punch Bowl or Jug by pottery artists at the order of sea captains visiting the port, together with casks of crockery for ordinary use.

The local deposits of clay provided suitable materials for Delft Ware, and the woods and forests in the neighbourhood provided the brushwood and timber for firing the kilns. Even during the early days of porcelain manufacture in Bristol (1770-1781), the china was fired with wood, the hauliers going as far as the Savernake Forest for suitable timber.

At this time it was produced by Richard Champion, a young Bristol merchant of prominent Quaker family. Champion's ware was made from a formula developed at Plymouth by William Cookworthy, reputed to be the first maker of "real English porcelain." Many difficulties had to be overcome before "true porcelain equal to the Asiatic" was produced, and the patent for its manufacture

CERAMICS

was by then coming to an end. Champion, therefore, petitioned Parliament for an extension of the Patent to recoup himself for the heavy capital outlay. The petition was opposed by Josiah Wedgwood, who wanted the materials made available to all potters. Champion was successful in the House of Commons, but the House of Lords inserted a clause which practically nullified the advantages granted in the other House. The costs attendant on the Parliamentary Bill, the collapse of his merchant trade with the American colonies owing to the War of Independence made it impossible to continue the porcelain works, so neither Cookworthy nor Champion reaped the harvest they deserved.

Processes Undertaken

In common with the usual practice in the out-potting districts, the Bristol Pottery is self-contained and practically self-supporting. It has its own power plant, calcines its own flint, manufactures its own glazes, and grinds and prepares its own raw materials. Making and firing are accomplished by modern equipment, the latter processes being carried out by continuous means in tunnel ovens fired either by gas or electricity. Gas is produced on the premises for glost firing, while the tunnel kiln for the printed and on-glaze decorations is fired by electricity. A roller conveyor system was introduced in 1946 for drawing the biscuit ovens. Several new automatic machines have been installed in place of the hand-operated jolleys and jiggers.

NEW NON-CORROSIVE PIPING

Distribution of cold water supplies, gases, compressed air and chemical products can now be made through a new lightweight non-metallic pipe called Marleythene manufactured by the Marley Tile Co. Ltd. The product, a thermoplastic tubing, has many advantages for domestic plumbing and in the chemical, agricultural, dairy and food manufacturing industries. It can be used for handling chemicals in liquid form, and in dairying it is ideal for milk and whey lines, being cheaper than the usual stainless steel and copper alternatives.

The tube resists corrosion and erosion by all types of soil and water, and is unaffected by acids or alkalis, or contact with building material. This factor makes it invaluable to farmers. Resilience makes it immune to frost no matter how severely or how often the water it contains is frozen.

High thermal insulation qualities prevent condensation forming so readily as on metallic pipe, and the tubing transmits far less noise and water hammer. It is a non-conductor of electricity, and remains undamaged by stray electric currents.

The tube softens with heat. This simplifies jointing and manipulation, but makes it unsuitable for use with hot water. It may, however, be used for waste pipes where internal pressure cannot be built up. Most of the jointing required can be made almost invisibly and the tube is easily installed. It has a long life without ageing.

Sir Winston's Garter in Chequers Window.—Sir Winston Churchill's recent installation as a Knight of the Garter has meant that a stained-glass window at Chequers, the prime minister's official country residence, has to be altered.

The window shows Sir Winston's Coat of Arms and his dates of office. Sir Winston's new honour means that the Garter must be added to his Arms, and the window has been taken from its place among the Arms of past Prime Ministers in the gallery at Chequers and sent to the Whitefriars glassworks of James Powell and Sons, at Wealdstone, Middlesex, where it will be altered.

The completed window will show Sir Winston's old Arms with the Garter circled round them, the whole inside a wreath. At the bottom the dates of Sir Winston's present term of office will be left uncompleted—not even the Chequers staff can forecast changes of government.



South African News

THE ceramics industry is growing in importance in the Union and even with the expected lifting of export control next year it is not expected that the gains made during the past six years will be lost.

It is possible that where overseas competition will be strongest will be in the sphere of novelty pottery and crockery. Little of the latter is produced in South Africa but the manufacture of ornamental and novelty ceramics has grown considerably in the past few years and manufacturers are hoping to retain their hold on the market. Considerable quantities of ceramic manufactures are at present imported into South Africa, with German manufacturers growing more prominent in this market, where at the same time British products continue to do well.

South African industry is now supplying a considerable percentage of the demand for the ceramics needed in the electrical industries and a good quality product is being delivered to them. Safety glass and many other sorts of glass are being made in South Africa, mainly by firms which are closely associated with overseas companies, so that the South African manufacturers have the benefit of technical advice and product supervision which ensures the manufacture of high quality products. For many of these ceramics items certain materials have to be imported, but so far as possible the local industry seeks to depend on raw materials obtainable in South Africa. For the production of a high-grade glass a low iron and manganese siliceous material is required.

This is usually in the form of sand. Suitable sands occur in the Union and the use of "rock silica" has been investigated by the Geological Survey Office. Vein quartz of a very high degree of purity occurred at the Modderfontein dynamite factory and in Natal. There is still plenty of scope for detailed research of these materials.

The production and utilisation of clays, refractory materials and minerals such as feldspar is of vital importance to the local ceramics industry, which has long been established in South Africa for the production of fire bricks, roofing tiles and other sorts of tiles, pipes and fittings, and fireclay and fireclay ware. Production of such items has increased considerably since the war, with the industry branching out into the manufacture of certain items

not previously made in the Union. Over the past seventy years or so, however, the ceramic industry has made valuable contributions to South African economy and even now it is felt there is plenty of scope for scientific research into available raw materials, although since the war some progress has been made.

The practical manufacturer concerned with the day to day problems of supply and production has always felt sure that there are local supplies of raw materials that could be developed if more precise information was available about them. From the soil science point of view a fair amount of data is available but in too many cases it is in a form of only limited value to the practical man. Thus it has been necessary for interested firms to finance research into promising materials and when good results have been obtained plants have been opened.

Progress of New Glassware Company

Laborglass (Pty.) Ltd., P.O. Box 8966, Johannesburg, are now engaged in the manufacture of a wide range of scientific glassware, which is made to standards claimed to compare with the best similar imported articles as regards price and quality. The range includes ampoules, test-tubes and laboratory apparatus. This firm has now been operating in South Africa for nearly six years, producing items that previously had to be imported. Recently it has undergone reorganisation with a new board of directors. The original plant consisted of a single machine operated by two experts, but since then the number of machines has been increased to six and the staff to about 25. The company is responsible for its own selling, although at one time it was represented by two selling agents. In addition to the production of complicated glassware for laboratory and other uses, the firm also repairs scientific glassware. Special requirements are also being made to order.

S.A. Bureau of Standards

In its latest annual report the South African Bureau of Standards states that four manufacturers of salt-glazed ware pipes and drain fittings were granted permission to use the standardisation mark, and regular inspection of their factories and products were undertaken by the laboratory staff. Work proceeded on the

CERAMICS

specification for white enamelled fireclay sanitary ware which has now been divided into six separate specifications for wash-hand basins, sinks, urinals, and high-level urinal cistern shells, wash-down water closet pans, trough closets, and block channel and semi-circular waterways, respectively. A Leitz heating microscope for determining melting points of refractory materials was acquired.

Marley Tiles in South Africa

The Marley Tile Company in England has formed a South African subsidiary, the Marley Floor Tile Co. (S.A.) (Pty.) Ltd., with a factory at Nigel, Transvaal, which cost about £200,000. The tiles are being made in the 9 in. by 9 in. size and are claimed to have many attractive decorative and other features. The Nigel factory has been designed and built under the supervision of British experts and it has been equipped with some of the most modern plant of its type, so that the South African product will in every respect be comparable to the British. About 50 per cent. of the materials used in the manufacture of these tiles have to be imported. The manufacturing range includes flooring tiles, feature strips, skirtings, special acid- and grease-proof tiles for factories and tiles for heavier industrial use.

Increase of Capital

Katinka Tiles (Pty.) Ltd., of Vereeniging, have recently increased their capital from £1,000 to £50,000.

Commercial Venetian Mosaics

Commercial-type Venetian mosaics are being produced for the first time in the Union at the Pretoria works of Universal Glass Industries (Pty.) Ltd. These are made in a variety of colours.

Because of the present limited market for mosaics, the company is also producing a variety of other glassware including glass bricks, accumulator cases, electric light globes and ash-trays.

Ceramics and Glassware from Germany

An entirely new range of "Dia" glassware and ceramics have been received in Johannesburg by Charles Baruch (Pty.) Ltd., South African representatives for Deutscher Innen und Aussenhandel, Berlin.

Ceramic Clays in South Africa

In view of the fact that practically no work has been done to determine the correlation between the colloidal, chemical, mineralogical, and physical properties of South African clays, the National Chemical Research Laboratory has been investigating an important group of clays, the chocolate-brown plastic fireclays of the Transvaal where the production of

ceramics is an important industry. These clays, which are both refractory and high in alumina, are used for the workability they impart, a characteristic which is useful in the manufacture of extruded ceramics such as sewer pipes. They are also useful as binders for alumina refractory bricks which are dry pressed.

Glass Company Merger Proposed

Consolidated Glass Works proposes to absorb the entire share of capital of Union Glass, which would thus become a subsidiary of Consolidated Glass.

If the merger is completed, the three existing bottle-manufacturing factories in the Union will fall under one control and thus enable substantial economies in planning and production.

SCANDINAVIA COMPETES FOR U.S. MARKET

VISITING North America at the request of twenty or so leading museums, a "Design in Scandinavia" exhibition, valued at \$125,000 and comprising a range of about 700 common household items, including a good deal of pottery and glassware, is proving very attractive to both Americans and Canadians.

After visiting the United States where, it is reported, it favourably impressed importers and several of the big departmental stores, the exhibition has now moved into Canada under the patronage of the Governor General, Mr. Vincent Massey, where it opened at the Royal Ontario Museum, Toronto. It is supported in Canada by the National Industrial Design Council.

The goods being displayed are designed and produced in Norway, Sweden, Denmark and Finland for everyday use and are not museum pieces. The initial costs of the exhibition were paid for by design societies in the four Scandinavian countries and a four-man international jury decided what was to be included in the display.

Indian Tariffs.—In a resolution on the Tariff Commission's Report on the continuance of the protection of the sheet glass industry, the Indian Government have accepted the Commission's recommendation that protection to the industry should be continued for a further period of three years from 1st January, 1955, and that the rate of protective duty should be increased with immediate effect to 70 per cent. *ad valorem* on sheet glass.

New Chemical Product Display

RECENTLY Xzit (Great Britain) Ltd. displayed to the trade and technical press the variety of products which are manufactured and used both at home and abroad in the marine and industrial fields. They fall under the general headings of fuel additives, solvents, anti-corrosion coatings and refractory products.

Refractory Product

Among the refractories the product "Brickseal" is probably best known and is used for bonding, coating and patching refractory bricks with the object of prolonging their life. It finds application in all types of boilers and furnaces and with a variety of bricks providing the silica content is less than 75 per cent. The "Brickseal" materials are either air setting or vitrifying. Among the latter, glazes are produced for use where spalling due to changing temperatures and chemical attack are severe.

Anti-Corrosion

Among the anti-corrosive coatings is "Serviron Dampcoat," which is an anti-corrosive material which remains plastic permanently. It can be applied to damp surfaces or under water, and used where ordinary lubricants are displaced by the presence of water. Shipping companies have used it to protect drinking, fresh and salt water tanks on board ships, and its life in some instances has been from five to six years without renewal. Many obvious applications are corrosion protection in inaccessible places such as behind

panelling, bathrooms, etc. In addition, structural steel and underground pipelines, railway lines in tunnels, conveyors—in short, wherever it is difficult to obtain access for normal corrosion-resisting materials. "Dampcoat" prevents electrolytic action and inhibits both bacteria and fungus growths so that it is effective for both wood and concrete. Its working temperature ranges from 14° up to 150° F.

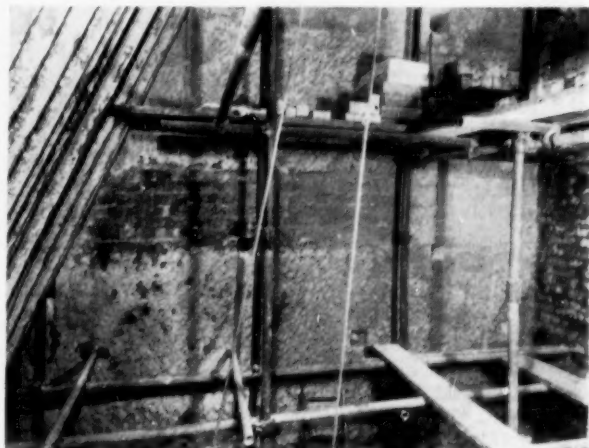
Recently the Company introduced another anti-corrosive material called "Hydrotemp"—it has similar properties to "Dampcoat" but may be used at temperatures up to 400° F.

Fuel Additives

A somewhat newer series of products by Xzit (Great Britain) Ltd., are their fuel additives, which may be used in both furnace and diesel fuels. Their main contribution is to reduce maintenance costs and increase the operational availability of plant. One material, a soot and sludge remover, may be used with all fuel oils including creosote pitch. This breaks up the sludge, allowing fuel which would otherwise be wasted, to burn without interruption. It prevents sludge formation in storage tanks and diminishes the clogging of fuel lines and filters. It contains a combustion accelerator which helps atomisation and thus improves the combustion of the fuel.

Another product is a firescale and soot eradicant. It reduces the residual products of combustion making them easily removable by blowing and brushing.

A portion of the side wall in a combustion chamber, cleared of slag and fly ash, and showing the condition after 12 months' service since laying-up and coating the bricks with Xzit Brickseal Bond. The fine joint between the bricks and the coating of the hot face surface has prevented spalling and break-away



CERAMICS

Diesel fuel additives are made for marine engines as well as industrial and heavy traction diesels. They break up the binders in burnt carbon and the combustion accelerators which lower the ignition rate of the carbon, and prevent deposits in the combustion chamber. One particular local authority was able to run double-deck buses for twice their normal mileage before overhaul.

Cleaner for Fuel Tanks

Other products include a universal degreaser to disperse oil and grease

deposits—one particular use being fuel tank cleaning in tankers. Another material, "Vantri," may be used in places where water in any form or quantity must be avoided—cleaning fuel oil heaters, lubricating oil coolers, commercial refrigeration and air-conditioning coils, and generally where the system is fouled with a hard-finish sludge. Sometimes it is used with the soot and sludge remover to remove sludge quickly.

Further information is obtainable from Xzit (Great Britain) Ltd., 175 Piccadilly, London, W.1.

GLASS TO GLASS CEMENT

DEVELOPED by German scientists in association with the firm of Glasbau Hahan an adhesive has now been introduced into this country which effects a permanent and efficient bonding between glass and glass.

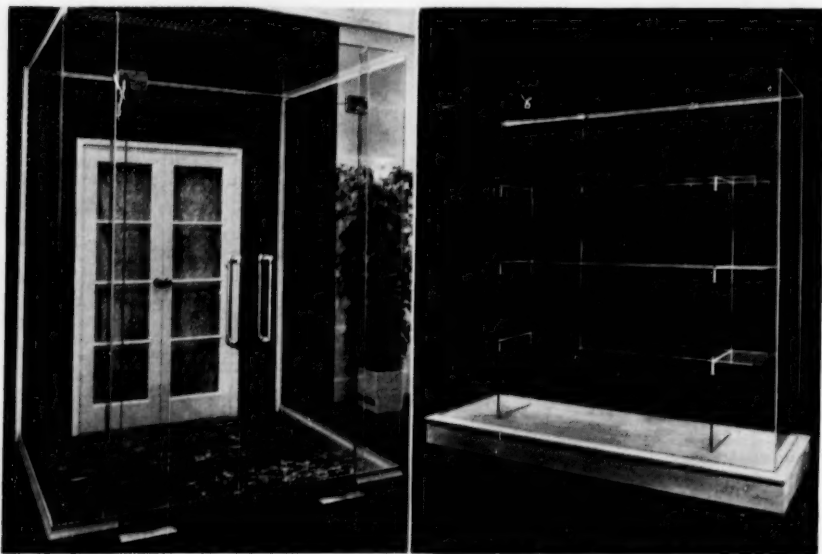
In the past, the modern trend, particularly in shopfront and showcase work, has been seriously hampered by the lack of a cement by which glass could be permanently fixed to glass without the necessity of providing a wood or metal support.

Owing much of its success to the fact that it hardens only in the outer portions

of the joint, the inner portions remaining permanently resilient, the new "S.H." glass cement is unaffected by climatic conditions and, it is claimed, is widely used on the Continent for exterior work. The cement is white and the finished joint does not detract from the appearance of an all-glass structure.

Plate Glass also Suitable

Suitable for use with plate glass of 1 in. thickness upwards, "S.H." glass cement can be applied to butted or mitred joints. Plates of any size may be



(Left) All-glass entrance porch, incorporating "Armourplate" doors and "Armourplate" soffit. (Right) Free-standing vitrine—note shelves and supports in all-glass construction

cemented together to form a self-supporting structure. Shop-front plates may be cemented edge to edge to form a continuous window of any length and armourplate doors can be incorporated.

To prove the efficiency of the new cement the makers cemented a piece of $\frac{1}{4}$ -in. plate glass, a few inches square, edge on to the top surface of a similar plate, the back of which was then fixed to a wall, leaving the first plate standing

out like a small shelf. By means of a bracket a load of 60 lb. was suspended at a position 2 in. distant from the joint without the connection breaking. When such tests have been made and the load has been increased to breaking point it is claimed that it has often been the glass and not the cement that has failed.

The new cement has been introduced into this country by James Clark and Eaton Ltd., of London.

STABLE BLOCKING MATERIAL

PRINTERS often find the mounting of photo-engravings a troublesome problem. Most of the difficulties stem from the necessity of using blocking materials that are less than ideal. Seeking a solution to these difficulties, Photo-engravers Research Inc. sponsored an investigation at Battelle Institute, Columbus (Ohio). The research led to the discovery of the desirable properties of Trancell materials for use in mounting photo-engravings.

One of the first steps taken by the Institute's graphic arts technologists was the determination of the properties of an ideal blocking material. These were found to be:

1. Absence of warping, swelling, and shrinking, regardless of humidity.
2. Dimensional stability.
3. Machinability.
4. Resistance to printing and moulding pressure.
5. Plate adhesion.
6. Resistance to ink and plate washes.
7. Lightness of weight.
8. Low cost.
9. Easy availability.

Another stage in the investigation was the evaluation of various materials. Ceramics were found to be the most promising. Of these, Trancell materials, composed of asbestos and inorganic binders moulded into sheets by heat and pressure, were the best.

Trancell HW is commercially available in the United States as a prepared blocking material, under the trade name Wellrite.

FILM-TYPE RESISTANCE ELEMENTS

THE United States Air Force is seeking fixed resistors that will operate at high temperatures and which will be suitable for use in both tropical and frigid climates. To be satisfactory, such resistors must (1) exhibit a temperature coefficient of resistance of less than 0.01 per cent. per ° C. and cover the resis-

tance range from 10 ohms to 10 megohms and (2) have good stability at temperatures from -65° C. to +200° C. They must also have low voltage dependence and be unaffected by temporary electrical overloads or by vibration.

A survey indicated that film-type resistors, which employ a thin film of nitride of chromium or of nitride of chromium-titanium deposited on ceramic bases, were likely to fulfill the requirements. A study of such resistors is now in progress at Battelle Institute, Columbus (Ohio).

Test on resistors of three types show that they have great promise. Pretreated resistors exhibited resistance changes from 0.001 per cent. at 100° C. to 0.8 per cent. at 200° C. and 6.7 per cent. at 250° C. over a 200-hour period. A test of load-life characteristics, which covered 1,000 hours at 200° C. with 1-watt loads, showed about 6.5 per cent. increase for both types without protective coverings. Sealed in glass, chromium nitride showed only 0.2 per cent. increase under the same conditions. Moisture-resistance tests generally showed less than 3 per cent. change in 500 hours.

GAS IN THE POTTERY INDUSTRY

THE largest Towns gas-fired kiln in Britain for firing sanitary fireclay ware has been installed in the works of Twyford Ltd., of Cliffe Vale, Stoke-on-Trent.

The kiln is a muffle type, 416 ft. long, and consumes 10,000 c. ft. of gas per hour giving an annual consumption of 87 million c. ft. or 435,000 therms. Incorporating all the latest devices for the efficient use of Towns gas, it has replaced eleven coal-fired, intermittent Scotch kilns.

There are now 272 gas-fired kilns used in the pottery industry, the first being installed in 1932. During the year ending 31st March, 1954, the quantity of gas used purely for pottery firing amounted to 24,342,000 therms—a fraction under 90 per cent. of all the industrial sales.



The new Wedgwood Room at Bourne-mouth is designed to display to advantage Wedgwood ware

WEDGWOOD ROOM AT BOURNEMOUTH

ON 1st November another Wedgwood Room was opened, this time at Beale's of Bourne-mouth, on their new lower ground floor.

Adjacent to the existing china and glass department, the room has been designed by Alec Heath, M.S.I.A., and incorporates the now familiar Wedgwood Room shadow box technique and table settings. A new feature is the tables themselves specially designed for Wedgwood by Gordon Russell Ltd., and made of West African mahogany with Nigerian cherry tops. One of the main staircases to the floor comes down at the side of the Room which can be seen through a large glass panel providing an effective setting for Wedgwood Jasper and other

"fancies." These are arranged on glass shelves supported by specially designed cantilever brackets by Church and Co., of Reading. This display is lit by recessed Merchant Adventurers lighting fittings, fitted with louvres each containing 75-watt mirrored-back bulbs.

The room is rib-panelled in West African Guarea mahogany with doors, etc., in Queensland maple. The room is L-shaped and one of the designer's difficulties was the varying height of the ceiling. This he effectively overcame by bringing the lighting down to one level, using spun metal fittings anodised in brass. The Wedgwood Room offered a large and comprehensive selection of Wedgwood, specially displayed and a factory-trained staff to sell it. Each single piece could be bought separately and replacements would be obtainable for many years to come.

Scottish Works Demonstration.—The value of demonstrations in the promotion of china, pottery and glass is being again stressed by many of the major manufacturers, co-operating with local retailers. In Kilmarnock in November, Lauder's of Kilmarnock staged a special "Trentham Bone China" demonstration, when specialists from the china works attempted to show the processes of production, from start to finish. A full show of tea and breakfast ware, teapots, morning and coffee sets, was displayed and specialists were present to advise on the points raised by the demonstration.

New Scots Brickworks.—The opening of a new brickworks at Brora in Sutherland in November, at a cost of approximately £70,000, marks the expanding tempo of industrial activity in the far north of Scotland, where hydro-electricity,

atomic energy production (at Dounreay) and peat harvesting for power generation are altering the traditional picture. There was a brickworks at Brora previously which provided a considerable flow of bricks for the north, meeting the problem of high cost of transportation from the industrial midlands of Scotland. But at the start of the last war, the machinery was dismantled and then sent south because of lack of labour—and limitation of need—over the period. The new plant will employ about twenty men and will produce some six million bricks a year. It is a much more modern and ambitious project with mechanical diggers to extract the clay and a modern Hoffman kiln set up. The project is sponsored by the Brora Coal and Brick Co. Ltd., of which Sir David Robertson, M.P., is chairman and it is very much a result of his initiative that the new industry has been achieved.

OPTICAL GLASS RESEARCH INSTITUTE FOR INDIA

AT recent meetings of the Board and Governing Body of the Indian Council of Scientific and Industrial Research held at New Delhi, the immediate setting up of a pilot plant at the Central Glass and Ceramic Research Institute, Calcutta, for the production of optical glass was approved.

In coming to this decision the Board had in mind not only the possibility of the pilot plant meeting part of the national demand for optical glass but also the help it would give in keeping the country abreast of scientific development in the production techniques of this material, which is used in the manufacture of binoculars, cameras, scientific instruments and other strategic goods and which requires continual scientific research.

The director and two scientific officers of the Central Glass and Ceramic Research Institute have received the necessary training for the purpose at the National Bureau of Standards in Washington, U.S.A. The proposed pilot plant will cost Rs. 500,000.

Among the research projects sanc-

CERAMICS

tioned by the Governing Body of the Council on the recommendation of the Expert Research Committees were: the plasticity of Indian clays by Dr. D. Lahiri, University of Calcutta; utilisation of blast furnace slag by Dr. D. Lahiri, University of Calcutta; and the influence of allotropic forms of silica upon the maturing and firing characteristics of glazes, etc., by Dr. S. S. Das, Benares University.

Ceramics prize-winner.—The annual prize offered by the members of the Industrial Art Committee of the Federation of British Industries to a student of the Royal College of Art has been awarded this year to Mr. Kenneth Sproson, a designer of ceramics.

Mr. Sproson first studied at the Wolverhampton College of Art and has now completed his third year at the Royal College of Art, where he has been awarded a first-class diploma and a fourth year continuation scholarship. During the coming year he will be doing design work for Josiah Wedgwood and Sons Ltd. His speciality is the use of underglaze colour. With the help of the F.B.I. award, which has to be spent on travel, Mr. Sproson intends to make an extensive tour of France and Italy.



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BUILDING RESEARCH COUNCIL

The Documentation Section of the International Council for Building Research, Studies and Documentation has recently begun the publication of a bulletin which is to appear regularly in three languages: English, French and German. The object of this venture was threefold; namely, to establish a tie between the various types of members of the C.I.B. (Conseil International du Batiment), in order to strengthen both personal and professional contact; to attract new members for the C.I.B. and new collaborators for the various activities of the Council; to promote international, and especially European, co-operation in the sphere of building research, studies and documentation, in which connection the contents and the volume of the C.I.B. bulletin will, it is hoped, prove a guide to the degree of this co-operation.

The C.I.B. has correspondents in every West European country, the representative for the United Kingdom being K. Alsop, of the Building Research Station, Garston, Watford.

The first three issues have already been published and display a wide variety of news on building activities in many countries. The publication should prove of great interest to both the manufacturers and the users of building materials.

Fire Cements.—We have received from J. H. Sankey and Son Ltd., a new leaflet entitled "Sankey's Fire Cements." This gives full particulars of Pyruma and Aluma fire cements and Siluma hot patching cement. Pyruma fire cement is used in the construction and maintenance of fireclay and semi-silica linings. It withstands intense and intermittent heat up to approximately 1,580° C. Aluma plastic fire cement is used for bonding firebricks with an alumina content of 40 per cent. and upwards. It is used for setting, patching, pointing, rendering and washing. It will withstand temperatures up to approximately 1,800° C. Siluma hot patching cement gives good results for the hot patching of fireclay, semi-silica and silica surfaces. It has high refractory properties.

Copies of this leaflet may be obtained from the company at Refractories Works, Ilford, Essex.

Acid-Resisting Cement.—J. H. Sankey and Son Ltd. have also recently issued a leaflet giving details of their "Super Acid-resisting cement." This cement is chiefly used in the bedding and jointing

of vitrified bricks and tiles in the construction of acid-resisting floors, walls and tanks. It is also used extensively for jointing pipes carrying acids and acid fumes. The cement cannot, however, be used for making concrete and the manufacturers do not recommend it for use where alkalis come into contact with it.

The new leaflet is very informative and gives clear indications as to the use of the cement and directions for its application. The leaflet may be obtained on request from J. H. Sankey and Sons Ltd., Refractories Works, Ilford, Essex.

David Leach in Scotland.—Mr. David Leach, the well-known artist potter, travelled north to Scotland in November to attend the Art Centre in the Royal Mile, Edinburgh, to give a demonstration of pottery-making to enthusiasts who gathered from all over Scotland. Mr. Leach brought with him from St. Ives in Cornwall his potter's wheel which he himself designed and a film which gave a comprehensive picture of work in the Leach pottery. At the present time this workshop is turning out some 22,000 pottery pieces a year with a staff of twelve, and during the visit Mr. Leach spoke about the methods and processes in use. The visit was of particular interest to Scottish potters because of the steady expansion of craft work by artist potters there in recent years, quite a number of art students having established themselves as craft potters, to meet the growing demand of gift ware by the tourist trade.

British Stained Glass for U.S.—A London glassworks has completed a stained-glass window for St. Thomas's Church in Fifth Avenue, New York.

The window includes five 20-ft. high lights, set off by forty-three pieces of tracery.

The window will be shipped in eleven crates at the end of November from the Whitefriars Studios of James Powell and Sons Ltd., where the thousands of pieces of glass that make up the fabric of the window are at present being assembled for inspection.

Figures shown in the window include St. Thomas Aquinas, St. Clare, Abraham and Elijah being fed by the ravens.

R. N. Jukes.—Mr. R. N. Jukes, of the development department of Quickfit and Quartz Ltd., of Stone (Staffs), lectured (on 12th November) on the subject of "Scientific Glass Apparatus" to a joint meeting of the Southampton University Chemical Society and the Royal Institute of Chemistry, Mid-Southern Counties Local Section.

APPOINTMENT VACANT

BRITISH TITAN PRODUCTS CO. LTD., has a vacancy for a male GLASS/CERAMIC/ENAMEL TECHNOLOGIST for applied Research in its Technical Sales Service Department at Billingham, County Durham. Whilst academic qualifications of degree standard would be desirable nevertheless consideration would be given equally to unqualified Technologists with practical or industrial experience. Applicants should preferably be under thirty-five years of age. Conditions of work and service are very attractive and there are Staff Bonus and Superannuation Schemes and non-contributory Life Insurance cover. Commencing salary dependent on age, qualifications and experience. Application forms may be obtained from the Personnel Manager, British Titan Products Co. Ltd., Coppergate, York, quoting reference S.18P.

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ADVERTISERS' INDEX

Aerograph Co. Ltd., The ... November
 Amalgams Co. Ltd., The ... October
 Applied Heat Co. Ltd., The ... 433
 Associated Lead Manufacturers Ltd. ... 438
 Berk, F. W. and Co. Ltd. ... 476
 Blending Machine Co. Ltd. ... November
 Borax Consolidated Ltd. ... 442
 Boulton, William Ltd. ... November
 British Ceramic Service Co. Ltd. ... Cover ii
 British Electrical Development Association ... 435
 Christopherson, Clifford and Co. Ltd. ... 473
 Cyclo Gear Co. Ltd. ... November
 Davies, James (Burslem) Ltd. ... 438
 Dohm Ltd. ... 459
 Electrical Rewinds (Burslem) Ltd. ... 462
 English Clays, Lovering, Pochin and Co. Ltd. ... 476
 Gas Council, The ... 440
 Gibbons Bros. Ltd. ... Cover i
 Greening, N. and Sons Ltd. ... September
 Grose and Stocker Ltd. ... November

Honeywell-Brown Ltd. ... November
 Kent, James Ltd. ... 437
 Lafarge Aluminous Cement Co. Ltd. ... 439
 Malkin, F. and Co. Ltd. ... 434
 Morgan Crucible Co. Ltd. ... Cover iii
 Nu-Swift Ltd. ... 456
 Potteries Ventilating and Heating Co. Ltd. ... 453
 Protolite Ltd. ... 436
 Rapid Magnetic Machines Ltd. ... November
 Rawdon Ltd. ... Cover iv
 Sismey and Linforth Ltd. ... November
 Sprechsaal ... November
 Sugg, Wm. and Co. Ltd. ... 436
 Tangyes Ltd. ... November
 Thermic Equipment and Engineering Co. Ltd. ... September
 Victoria Heating and Ventilating Co. Ltd. ... 434
 Wadsworth, Wm. and Sons Ltd. ... November
 Wengers Ltd. ... 466
 Wilkinson Rubber Linatex Ltd. ... November

This is an Arrow Press Publication. Published Monthly.

Subscription Rate 25s. per annum.

*Published by Arrow Press Ltd. at 157 Hagden Lane, Watford, Herts.
 Telegrams: "Techpress, Watford." Telephone: Gadebrook 2308/9.*

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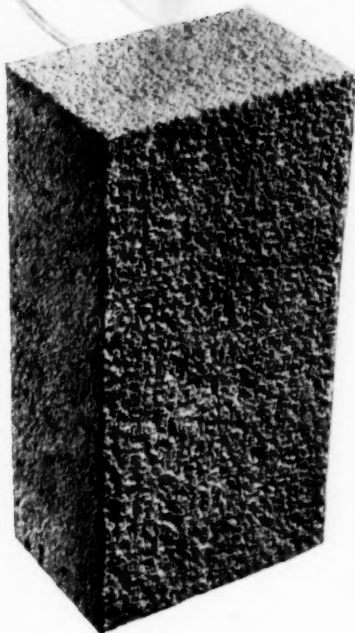
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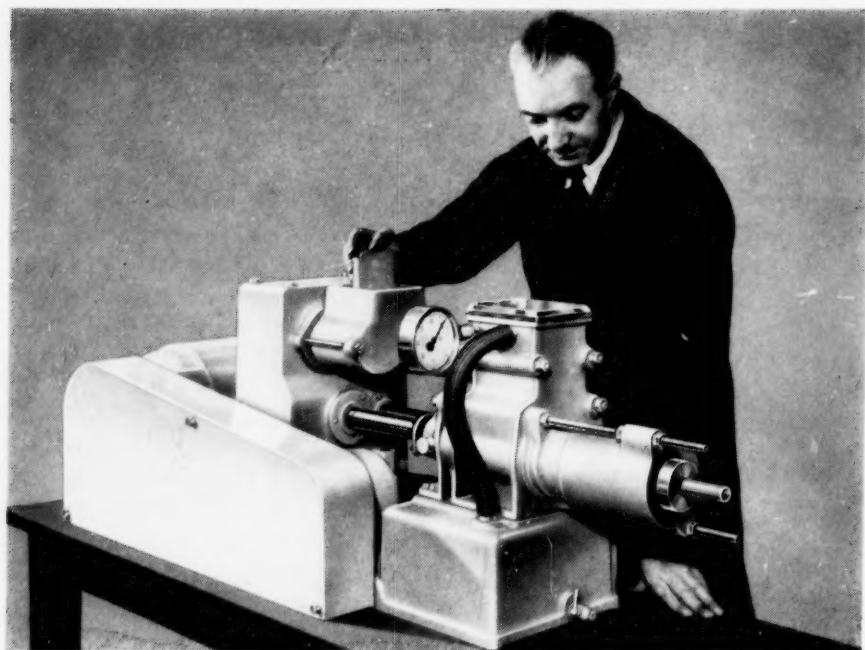
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